

SECTION E, PART 0

INTRAOFFICE CALL TROUBLE CARD ANALYSIS

Index

	<u>PAGE</u>
EO INTRAOFFICE CALL TROUBLE CARD ANALYSIS	EO-2
EO-1 FLOW CHART AND TROUBLE ANALYSIS SEQUENCE CHART	EO-2
EO-1.1 USE OF FLOW CHART AND TROUBLE ANALYSIS SEQUENCE CHART	EO-2
EO-2 SEQUENCE CHARTS	EO-3
EO-3 CROSS DETECTION, SEQUENCE FAILURE (SFD-E002)	EO-4
EO-4 TIMING FUNCTIONS	EO-4
EO-4.1 OVERALL TIMER (OAT)	EO-4
EO-4.2 WORK TIMER (WT)	EO-4
EO-4.3 SHORT DELAY TIMER (SDT) AND LONG DELAY TIMER (LDT)	EO-5
EO-4.4 TRANSFER START TIMER (TRS)	EO-5
EO-5 FALSE CROSS-GROUND TEST (FCG)	EO-5

EO INTRAOFFICE CALL TROUBLE CARD ANALYSIS

The trouble analysis flow charts located in part SFD-A2-- directs the user to one of the oblong boxes† on the left side of sheet SFD-E002 for intraoffice call trouble record cards. The flow chart supplies information and directs the user to the trouble analysis sequence chart which in turn refers to a sequence chart.

EO-1 FLOW CHART AND TROUBLE ANALYSIS SEQUENCE CHART

The flow chart on SFD-E002 is used in the same manner as the trouble analysis flow chart in part SFD-A2--. The user, having determined the type and stage of call from SFD-A2--, is directed to SFD-E004 or SFD-E005. Then by observing the trouble record card and making decisions, the craft person is directed to needed information or directed to the trouble analysis sequence chart.

Standard sequence charts generally show a sequence of relay operation and release. All relays are shown that relate to a particular function. Trouble record punch indications are shown at the point in the sequence when ground is applied to or removed from the lead to the trouble recorder. Trouble analysis sequence charts omit relays shown on the regular sequence chart, except those relays associated with the trouble record designations (SFD-A103). A designation on the trouble analysis sequence chart without a punch symbol indicates the point in the sequence where that designation would be punched if a trouble record were taken. A designation with a triangle (base down) to its right indicates the point in the sequence after which a designation would not be punched.

EO-1.1 USE OF FLOW CHART AND TROUBLE ANALYSIS SEQUENCE CHART

This part will demonstrate the use of the flow chart (SFD-E002) and the trouble analysis sequence charts (SFD-E004/E005). A craft person experienced in the use of trouble record cards may find this section basic, but the procedures shown here (even though they may become automatic) are the procedures a qualified craft person must perform.

† Symbols used in flow charts are described on SFD-A103.

With a selection of trouble record cards to distribute to the reader, certain functions must be assumed. It is assumed that all trunks, trunk links, line links vary. The only equipment that remains the same on all cards is the marker. Following the flow chart (SFD-E002), it is identified that the MXT punch is not indicated. The path to follow is marked N (No). The WT punch is indicated on the trouble record. The path to follow is marked Y (Yes). This procedure continues through the FCG N (No), the TK Y (Yes), the HMS1 Y (Yes), and the DCT1 Y (Yes) and the LK1 N (No). The flow chart directs the reader to (SFD-E004) the call forward stage of the call (FLG). Assuming the call has progressed to the Subscriber Call Back (SCB) stage the procedure would be the SCB Y (Yes), the TK Y (Yes), the HMS1 Y (Yes) the DCT2 Y (Yes) and the DIS1 N (No). The flow chart directs the reader to the (SCB-E005).

The trouble analysis sequence chart, and all sequence charts, operate from the top of the page to the bottom. To identify the trouble area the reader must start at that point of major failure and back-track to the point where all punch indications (leading to the branch in trouble) are shown.

To demonstrate the procedure when analyzing a trouble record in the FLG stage (SFD-E004): Working back from the LK1, the DCT1 is indicated, by the punch, that the DCT1 relay has operated. (The reader must now follow the operate path for the LK1 relay). The problem exists between the LK1 and DCT1 indications. SFD-E004 double lined box for the LK1 indication directs the reader to SFD-E503 for more detailed information. The same analyzation procedure is used on SCB (SCD-E005) as used for the FLG stage of call.

EO-2 SEQUENCE CHARTS

The sequence charts used in the SFD follow standard conventions for sequence charts, except as noted on SFD-A103.

The example in EO-1.1 demonstrating the procedure used when analyzing a trouble record in the FLG stage of an intraoffice call is continued on SFD-E503. The operation of the LK1 is an indication of linkage check for the FLG stage of the call. Using sequence chart SFD-E503 we see that we must come through the operated DCT1 relay and normal DCT relay in order to operate the LK1 relay. By checking the relay index we find that the operate path for the LK1 relay is shown on SFD-E712. We should now follow the path on SFD-E712 from the LK1 relay through the operated contacts of the DCT1 relay through the normal contacts of the DCT relay to the PU relay ground.

EO-3 CROSS DETECTION, SEQUENCE FAILURE (SFD-EO02)

For either of the double sided trouble cards, there is an MXT designation which is punched if there is a cross detected (X--) or if there is a sequence failure (SQA) of the junctor walking circuit. For the single sided trouble card, there is no MXT punch and it is necessary to scan all the X-- designations and the SQA designation to determine if there is a cross or sequence failure. The reader should proceed through each decision box following Y (Yes) if the designation is punched or the statement is true or N (no) if the designation is not punched or the statement is not true. If there is no MXT, cross or sequence failure, the procedure beyond that point is the same for all trouble record cards.

EO-4 TIMING FUNCTIONS

The DTM and CM are designed in such a way that they are timed from seizure until release. Critical functions are timed separately. Understanding the purpose and function of timing circuits will aid the craft person in understanding the behavior of the marker. General functions of the OAT, WT, SDT/LDT, and TRS timers will be discussed in this section. More detailed description of timing operations will be discussed in the El part.

EO-4.1 OVERALL TIMER (OAT)

The OAT is started when the CM is seized and is stopped when the marker is restored to normal. The timing interval is 9.6 to 15.4 seconds which is greater than the time required on any normal marker usage. This timer guards against failure of any of the other timers. Operation of the timer causes the marker to release without a trouble record but will sound a major alarm.

EO-4.2 WORK TIMER (WT)

The WT timer is started when the marker is seized and is stopped when the marker is restored to normal. The timing interval is 450 to 605 milliseconds. This short timer is used to detect troubles as soon as possible in order to quickly release the marker. The WT timer is recycled as the call progresses. Operation of the WT causes the marker to take a trouble record before releasing and will be the timer that will most often generate a trouble record.

EO-4.3 SHORT DELAY TIMER (SDT) AND LONG DELAY TIMER (LDT)

The SDT provides a delay of 2.6 to 4.5 seconds on service calls and 1.1 to 1.9 seconds on no-test calls. The LDT provides a delay of 4.6 to 7.5 seconds. Both timers are started by the operation of the seize frame (SF) and seize frame timer (SFT) relays. The operation of the SF stops the WT timer. The SF and SFT relays operate when the marker closes a start lead to select a frame such as the LL, TL, NG, OSC or FAT. The SF and SFT relays also operate on various test calls and on completion of the sender trunk guard test. The SDT timer always functions first unless the trouble recorder is busy. This condition requires the longer timing provided by the LDT. If the SDT should fail, the LDT, which is also timing will function as a back up.

EO-4.4 TRANSFER START TIMER (TRS)

The TRS circuit functions to transfer the marker connector start leads to the alternate marker preference whenever a marker is not seized in approximately one second. If the WT, SDT/LDT are not punched and the TRS is punched, the trouble record indicates that the marker connector could not connect to a CM within the transfer start timing interval and had to transfer its start leads.

EO-5 FALSE CROSS-GROUND TEST (FCG)

The FCG is the next punch designation which must be considered on the flow chart (SFD-E002) and will be discussed briefly at this time. During light traffic conditions the CM operates all hold magnets except the line hold magnet. The FCG relay is connected to the tip and ring leads and will operate if there is a cross between the tip and ring, a false ground on the ring conductor, or a false battery on the tip conductor. The FCG relay will lock operated, stop the marker progress, and force a WT time out.

SECTION E, PART 1

ESTABLISHING AN INTRAOFFICE TRUNK CONNECTION

Index

	<u>PAGE</u>
E	ESTABLISHING AN INTRAOFFICE TRUNK CONNECTION E1-3
E1	INPUT TO COMPLETING MARKER AND CODE TRANSLATION E1-4
E1-1	MARKER SEIZURE E1-4
E1-1.1	MARKER CONNECTOR RELAY CHAIN CIRCUITS E1-4
E1-1.2	CB- (MARKER CONNECTOR BUSY) RELAY CHAIN E1-4
E1-1.3	MS- (MARKER START OR PREFERENCE) RELAY OPERATE CHAIN E1-5
E1-1.4	MS- RELAY WORK CHAIN E1-5
E1-1.5	W AND Z RELAY CONTROL FOR TRANSFERRING START LEADS E1-6
E1-2	TIMING FUNCTIONS IN PREFERENCE CONTROL CIRCUIT E1-7
E1-2.1	TRANSFER START E1-7
E1-2.2	OVERALL TIMER E1-8
E1-2.3	WORK TIMER E1-9
E1-3	INFORMATION FROM THE ORMC TO THE CM E1-9
E1-4	GROUNDING A CODE POINT E1-11
E1-4.1	A DIGIT TRANSLATOR E1-11
E1-4.2	B DIGIT TRANSLATOR E1-11
E1-4.3	C DIGIT TRANSLATOR E1-11
E1-5	SERVICE TREATMENT, PREROUTE RELAY AND ROUTE SERIES RELAY OPERATION E1-12
E1-5.1	S- RELAY OPERATION, SC-, USC- AND S- CROSS-CONNECTIONS E1-12
E1-5.2	PREROUTE RELAYS E1-13
E1-5.2.1	LPA or LPB Local Physical Office A or B Relays E1-13
E1-5.2.2	Diverted or Denied Route Relays E1-13
E1-5.2.3	Operator Routes E1-13
E1-5.3	ROUTE SERIES E1-13
E1-6	TYPICAL ROUTE RELAY OPERATION E1-14
E1-7	INFORMATION TRANSMITTED THROUGH CONTACTS OF THE ROUTE RELAYS, R--- AND FC--- E1-14
E1-8	OPERATION OF THE CKG1,2; LLC1,2,3; ONX, TLC1,2 AND BX RELAYS E1-16

E1-9	ROUTE RELAY FUNCTIONS	E1-16
E1-9.1	FTC 0-29 RELAY OPERATIONS	E1-16
E1-9.2	TB0-5 (SD-26032-01) OR TB0-9 (SD-27879-01), TGO-9 AND TGP OR TGS	E1-16
E1-9.3	RA- ROUTE ADVANCE	E1-17
E1-9.4	NSI NO SENDER INTRAOFFICE	E1-17

E ESTABLISHING AN INTRAOFFICE TRUNK CONNECTION

An ITR (intraoffice) call is one between two customers in the same marker group. This type of connection requires a double ended trunk. One connection is established between the called customer's line appearance and the trunk link appearance of one end of the trunk; another connection is established between the calling customer's line appearance and the trunk link appearance of the other end of the trunk.

After translation and operation of a route relay, the call is recognized as an ITR call. This type of call requires a FLG (forward linkage) to be established to the called line first, followed by a CB (call back) linkage to the calling line. Marker work time is minimized by attempting to select the path from trunk to called customer first, in case the connection can not be made because of line busy, or channel busy conditions.

The general sequence of operation is as follows:

The CM (completing marker) determines the required route, and operates a route relay, as a result of translation of the called number, and the signals received from the OR (originating register).

A TL (trunk link) is selected containing an idle ITR (intraoffice) trunk by testing the FTC- leads, and the trunk is selected according to TB- and TG- information contained in the operated route relay.

Since the called number does not directly indicate the called line equipment location, a NG (number group) is called in to translate the called number into its equipment location on the LL (line link). This location is by FTT- (frame tens), FUT- (frame units), VGT- (vertical group), HGT- (horizontal group), and VFT- (vertical file). A ringing combination code is also received to control proper ringing for a particular called line.

The marker seizes the LL containing the called line in order to control selection of the line.

The channel test leads are closed through to select an idle channel between the called customer and one end of the ITR trunks, and the select and hold magnets are operated to connect the linkage through the LL and TL frames.

The established channel is checked for a satisfactory connection, and that the ringing switch operation is completed. The marker LK1,2 relays operated indicate that the FLG operation is completed and that advance must be made to set up the CB (call back) linkage.

Certain apparatus associated with channel selection, hold magnet control, and line equipment control is released for use with the CB linkage. The equipment location of the calling line is recorded from information contained in the OR. The LL is seized to provide marker control of the calling line.

The channel test leads are closed through for the call-back linkage to select an idle channel between the calling customer and the other end of the ITR trunk, and the select and hold magnets are operated to connect the linkage through the LL and TL frames.

The completing marker disconnects and restores to normal leaving the established ITR connection under supervisory control of the ITR trunk.

E1 INPUT TO COMPLETING MARKER AND CODE TRANSLATION

The CM (completing marker) determines the required route, and operates a route relay, as a result of translation of the called number, and the signals received from the OR.

E1-1 MARKER SEIZURE

Upon operation of a MST relay in the originating register (SFD-E104), start battery is applied to activate a marker start STA lead or a marker start STB lead to start seizure of a completing marker. As will be seen later, the Z relay is operated and released on alternate calls so that the STA and STB start leads are alternately activated on successive calls. Each register is given preference to one completing marker for an STA start and to another for an STB start by cross-connecting MSA and MSB punchings on SFD-E104 to appropriate MS- punchings on SFD-E105.

E1-1.1 MARKER CONNECTOR RELAY CHAIN CIRCUITS (SFD-E105)

Three chain circuits are used in selecting a completing marker and closing the connector relays between the register and the marker selected. The description of these chains which follows is typical of chains in other connectors.

E1-1.2 CB- (MARKER CONNECTOR BUSY) RELAY CHAIN

An operated CB- relay indicates that the associated marker is busy to the connector. A CB- relay operated for a preferred marker advances the start lead to the next preferred marker. If the CB- relay for that marker is also operated, the start lead is advanced to the next preferred marker, etc.

E1-1.3 MS- (MARKER START OR PREFERENCE) RELAY OPERATE CHAIN

In periods of very light traffic (and assuming no markers busy) MS-relay operation is straightforward. A start signal from a register operates the MS- relay associated with the MS- terminal to which the start lead is cross-connected.

In periods of heavy traffic one or more markers may be busy and two or more registers may initiate marker requests either simultaneously or in rapid succession.

Assume that the first and last registers (SFD-E105) initiate simultaneous marker requests. Also assume that both start leads are connected to MS0 (that is both prefer marker 0). The MS0 relay associated with each of the two registers will operate through the MSK cross-connection to ground in the marker. An early make contact on the MS0 relay for the first register will provide locking ground for that MS0 relay before the break contact on the MS0 relay for the last register opens the MSK ground. Thus, both relays will operate and lock.

If, however, the last register initiated a request for a marker slightly ahead of the first register, the MS0 relay for the first register could not operate. On the other hand, if the first register initiated a marker request first, a subsequent request by the last register could operate the MS0 relay for that frame.

E1-1.4 MS- RELAY WORK CHAIN

Since it is possible to operate two or more MS- relays at the same time, the work chain determines which MS- relay does the work. Ground for the work chain originates in the marker at the MAK cross-connection. It should be noted that the work chain proceeds through contacts of each MS0 relay in a reverse direction to the preference MSK chain. Contacts on the MS0 relay for the first register are, therefore, enabled to operate connector relays MA- through ME- whether or not any other MS0 relay is operated.

Upon operation of the originating register marker connector relays MA- through ME-, the MCB-relays of the selected marker are operated over the MB lead (SFD-E106). The MCB- relays operate CBO relays in every connector having access to that marker (SFD-E105). It should be noted that an operated MA- connector relay contact bridges the break contact of the CBO relay in the start path so that the operated MS0 relay is not released when the associated CBO relay operates.

If two or more MS0 relays had operated for different registers, the start lead for each of those which failed to get a marker would be advanced to the next preferred marker by operated CBO relays. If,

however, no other markers were available, no new MS- relay would operate until some marker became available, at which time one or more MS- relays for that marker would operate. This would continue until all registers has been served.

During periods of heavy traffic when all completing markers become busy, a traffic control circuit gates requests by registers for CMs as described in a subsequent section, so that all registers requesting service are served once before any register is served a second time. Relay MS- in operating releases the marker connector checks relays MAK, MCK, and MSK (SFD-E105). The release of any one of these relays operates relay TM (SFD-E108) which starts marker timing.

E1-1.5 W AND Z RELAY CONTROL FOR TRANSFERRING START LEADS (SFD-E104)

If only one start lead is provided, then, under light traffic conditions, a particular connector might seize the same marker for every usage. If this marker is in trouble, all calls from that register might be blocked. To prevent this and also to reduce the adverse effects of other circuit failures, two start leads are provided in each marker connector. By alternating the use of these start leads, two markers serve alternately as first choice markers, thereby providing more even wear on the marker connectors. This transfer is accomplished with a W and Z relay combination. The operation and release of relay Z provides the necessary transfer.

In the following description, assume that relay TRS (transfer start) is normal.

The W and Z relay combination (SFD-E104) operates as follows:

(a) FIRST CONNECTOR USAGE

- (1) Marker seizure - Assume that relays MA- through ME- of the originating register marker connector and W and Z of the preference control circuit are normal. Lead STA has continuity through the break contact of relay Z and lead STB is open. A marker is seized by operation of relay MS- via the MSA to MS cross-connection. Relay MS- causes the operation of relays MA- through ME-. Relay MD- operates relay MK in the preference control circuit (SFD-E104), which in turn operates relay W which locks.
- (2) Connector release - When the connector releases, release of the MD- relay releases relay MK which causes the Z relay to operate through the operated W. Relay Z locks operated from the ground of relay W which remains operated but the locking ground for W is now through the operated Z to the released MK. The operation of relay Z opens start lead STA and closes STB making it available for future usage.

(b) SECOND CONNECTOR USAGE

- (1) Marker Seizure - At this time relays MA- through ME- are normal. Relays W and Z are operated. A marker is seized by the operation of relay MS- via the MSB to the MS- cross-connections. Relay MS- causes relays MA- through ME- to operate. The operation of relay MK, this time, opens the locking path of the W allowing it to release.
- (2) Connector Release - The release of relay MK when the connector releases removes the Z relay holding ground, allowing it to release. Relay W remains released. The release of relay Z opens lead STB and closes lead STA making it available for the next connector usage. For subsequent usages the actions described above repeat.

E1-2 TIMING FUNCTIONS IN THE PREFERENCE CONTROL CIRCUIT

Timing circuits in the preference control circuit, control marker seizure and once the marker is seized, times its overall function. These timing circuits are discussed below.

E1-2.1 TRANSFER START TIMER (SFD-E108)

The transfer start timer allows an interval of 0.6 to 1.25 seconds for the OR to connect to a CM (unless all CMs are busy). If the connection is not established in this time interval, the preference control circuit transfers the start leads and gives a TRS signal to the CM to cause a trouble record to be taken, showing that there was a transfer start condition.

The operation of the MST relay in the OR operates the TM relay (SFD-E108). The TM relay operates the TM1 and also closes through the IM lead from the master traffic control to operate the IM relay. The IM lead will normally be grounded unless all CMs are busy, in which case operation of the IM relay is delayed until a CM becomes idle. The IM relay starts the TRS timer.

The TRS timer continues to time until the connector relays MA- through ME- operate. The check that the connector relays have operated, the MA-relay connects ground to the CKG lead to operate CKG1,2 relays. The CKG1,2 relay connects ground to the MTFC as a check that the connector relays operate. The MC- relay grounds the TC and TC1 leads to operate the TC and TC1 relays in the preference control circuit. The operated TC and TC1 relays in the PC opens the path to the IM relay (SFD-E108) which stops and recycles the TRS timer.

If a marker is not seized in approximately one second, (providing markers are available as indicated by ground on the IM lead), the TRS tube will fire and operate the TRS relay. The TRS relay opens the start lead in use, closes the alternate one (SFD-E104), releases the TM relay, in the preference control and holds the TMI relay operated (SFD-E108). The TM relay is released to open the signal leads CWA and TCA (SFD-E108) to the traffic control circuit to prevent its timing out because of a marker connector trouble. The TM relay also releases the IM relay to recycle the timer (SFD-E108). The TMI relay is held operated to continue the overall timing before a marker is seized. The TRS relay locks operated through the TMI relay. When a marker is obtained over the new start lead, the TMI relay releases upon operation of the MK relay. The TRS relay remains operated over its locking contacts under control of the MK relay. The TRS relay transmits to the marker the fact that the transfer has taken place. This information is passed over the TRS lead. The marker causes a trouble record to be taken showing a TRS punch and indicating the OR which encountered the TRS failure. Upon release of the marker, the MK relay, in releasing, will release the TRS relay.

E1-2.2 OVERALL TIMER (SFD-E107)

An overall timing circuit is provided which sounds the major alarm if an OR calling for a marker has not been connected to one within 4.6 to 10 seconds. It functions as follows: Upon the start of a call, operation of a relay operated the TM relay at the same time that battery is connected to the start leads for marker seizure. The TM relay operates the TMI relay which starts the overall TM timer (SFD-E108).

For normal operation, a marker is seized before the timing interval has elapsed. This is indicated by the operation of the MK relay from the operate marker multi-contact connector relays in the originating register marker connector circuit. The MK relay releases the TM and TMI relays. During the releasing time of the TM and TMI relays, the TM tube timer circuit is recycled by discharging the A capacitor through the C resistance. The TMI relay normal with the MK relay operated restarts the A capacitor charging circuit to time the release by the marker. If the marker releases the connector within the timing interval, the TM tube will not break down. However, should the marker exceed this time interval because of some trouble condition or should the marker connector relays remain operated due to a trouble, the TM tube will fire, operating the CA relay which brings in the major alarm and causes the ORMC- lamp at the JLK to remain lighted. This lamp normally flashes on each time the MK relay operates as an in-use indication for the ORMC. When it remains steadily lighted, it serves as an ORMC alarm indication.

The MK relay releases at the end of the call upon release of the originating register marker connector circuit multicontact relays and discharges the A capacitor to recycle the TM timer for the next call.

E1-2.3 WORK TIMER

When a marker is seized, the released MAK, MCK or MSK relay operates relay TM, timing marker off normal, which operates relay TMS, timing start. Relay TMS places a ground on one side of capacitor WT and opens the path through resistor WT3 which was shunting it. The WT capacitor becomes charged from the +130 volts battery placed on the side of it through resistor WT1. This causes the voltage on the control anode, terminal 1, of the WT tube to gradually increase through resistor WT2. If after .450 to .605 seconds the marker does not complete the particular function that is being timed, the control anode of the WT tube is increased to positive 72 volts, thereby causing the WT tube to conduct. When the tube conducts, it operates relay WT, work timer. Release of the TMS relay causes the WT capacitor to discharge through the WTS resistor. Because many marker usages exceed the short time interval provided, this timer is recycled as the call progresses. Operation of the WT timer causes the marker to take a trouble record before releasing. The SDT, LDT, TRTR, OAT and HTT tube timing circuits work basically the same as the WT tube timing circuit.

E1-3 INFORMATION FROM THE ORMC TO THE CM

When the ORMC- marker part multicontact relays (MA-ME) operate, information leads from the OR are extended to the CM. The information that passes to the CM is as follows:

<u>Lead Designation</u> <u>(From ORMC)</u>	<u>SFD Location</u>	<u>Lead Description</u>
A2/5 - G2/5 H7	E-115	Called numbers
LT	E-110	Translator to be used for translating area or office code.
CTA 2/5, CU 2/5, CRU 2/5, CGA, CGB, TP, RP	E-113	Subdivisions of customer class of service and treatment.
MF, D	E-111	Type of customer signaling, TOUCH-TONE or dial.
OR	E-110	Type of call.

<u>Lead Designation</u> (From ORMC)	<u>SFD Location</u>	<u>Lead Description</u>
FT 2/4, FU 2/5, VG 2/6, HG 2/5, VF 1/5, LL 2/5	E-114, E-111	Line equipment location on line link frame.
MRL, RL, BT, TRL	E-107	Release signals to register for normal busy, and trouble releases.
PS, PD, CR, SCN, PK, SCK, CNR	E-112	Trouble and check signals from register, permanent signal partial dial, coin return, stuck coin, permanent signal-partial dial check, stuck coin-coin return check.
CKG, TM	E-106, E108	Marker seizure from register.
OBS, NOB	E-111	Service observing or no service observing.
TRK, TR2, TRS	E-108	First and second trial, and start lead transfer signals.

The leads listed in the table above will operate related relays except the following:

- (a) A 2/5 - C 2/5 will operate the AC 2/5 - CC 2/5 relays.
- (b) D 2/5 - G 2/5 will extend through the operated N4 relay to operate the TH 2/5, HN 2/5, T 2/5, and U 2/5 SFD-E133.
- (c) The CTA 2/5 leads will operate the CT 2/5 relays.
- (d) The CU 2/5 leads will operate the CUA 2/5 relays.
- (e) The D lead will operate the DP relay.

El-4 GROUNDING A CODE POINT

The marker action for any call depends on directing information received from the register. The information required may come from a direct signal or from the translation of an office or area code. Marker translation consists of changing the code digit information into a single indication which is called a code point. Thus, the result of translation is to "mark a code point." Each digit is received on a 2/5 code basis. The called number information can be in any of various numbering plans, but in general, the number consists of the following:

- (a) 4 numerical digits
- (b) 1, 2, or 3 digit office code plug 4 numerical digits
- (c) A 3 digit area code, 3 digit office code and 4 numerical digits.

The examples used in this SCD will be 3 digit office code plus 4 numerical digits. Grounding or marking a code point requires three separate functions for a 3 digit office code, the A digit translator, the B digit translator and the C digit translator. The example will illustrate how to ground code point C983.

El-4.1 A DIGIT TRANSLATOR (SFD-E118)

The ground to operate the A digit translator originates on SFD-E118. Ground through XTA 5B (break) through CKG2 6M (make) through OR 12M through FAC 12B, through SCN 8B, through SCK 8M, through CR 7B, through PS 4B, through PD 6B, through PK 6M, through PK 4M, through SCN 6B, through OR 11M, through AC-0 4B, through AC-1 4B, through AC-2 4M, through AC-4 6B, through AC-7 6M, through AC-2 5M, through AC-7 2M through LT 10M to the cross-connect punching LTA 9. This punching is cross connected to ATW 9 and operates the A digit translator relay, AT 9.

El-4.2 B DIGIT TRANSLATOR (SFD-E119)

The ground to operate the B digit translator originates on SFD-E119. Ground through CKG2 8M, BC-0 4B, BC-1 4M, BC-2 6B, BC-4 6B, BC-7 6M, BC-1 5M, BC-7 5M, and AT-9 9M to ground punching AT98. The same ground extends through BC-1 10M and BC-7 10M to operate the B258 relay. The cross-connect punching AT98 is cross-connected to BT9T (see table SFD-E119) to operate the BT9T relay.

El-4.3 C DIGIT TRANSLATOR (SFD-E120)

The ground to operate the C digit translator originates on SFD-E120. Ground through CKG2 7M, CC-0 4B, CG-1 4M, CC-2 6M, CC-4 8B, CC-7 8B, CC-1 3M, CC-2 3M, B258 4M and BT9T 23M to ground code point C983.

E1-5 SERVICE TREATMENT, PREROUTE RELAY AND ROUTE SERIES RELAY OPERATION

A route is not necessarily identified by the grounded code point alone, but usually requires a combination of code point and class of service, service treatment, and may require preroute and route series relay operation.

E1-5.1 S-RELAY OPERATION, SC-, USC- AND S- CROSS-CONNECTIONS

As previously described, the translation of a code grounds a code point. Customers and trunks are assigned classes to aid in determining the route a call will use. The process of combining code point and class to identify a route is called service treatment. This service treatment is accomplished by using S-, screening relays and their associated cross-connects. The S-relay contacts are wired to USC- and S- punchings (SFD-E125-E132). Cross-connections between S-punchings and route relays control the selection of a route when service treatment is required. All classes, customer and trunk, (trunk class will be discussed in detail in SFD Section D) are served by a common group of service treatment relays. The marker has capacity for a maximum of 180 relays; 60 of them are located on the translator and code treatment frame, 60 are located on the supplementary service treatment frame, and 60 are located on the auxiliary supplementary service treatment frame. These relays are furnished on single mounting plate units. Each unit has 12 relays each having 12 make contacts and two D type terminal strips. The control winding terminal of each relay is wired to an SW- punching on terminal strip TA. The SW- punching number will be the same as the S-relay number. The 12 fixed contacts on each relay are wired in multiple to three other relays on the same unit and the common multiple is connected to 12 punchings designated USCO-11 on the terminal strip. The 12 make contacts of each relay are wired to 12 individual service treatment punchings SO-11 on terminal strip TM. The S- relay contacts count 1-12 so that the USCO punching is wired to S- relay 1 fixed. The SO punching is wired to S- relay 1 make. The wiring pattern on each mounting plate unit gives three sets of four relays and each set of relays has 12 USC-punchings on the unit terminal strip.

The marker is arranged for 120 service common SC- punchings, which appear on cross-connection terminal strips on the translation and code treatment frame. Sets of 12 SC- points; SCO-11, SC12-23, etc, are connected by means of loose wire on the rear of the frame to USC-points on the S-relay unit terminal strips. The loose wire is assigned on a job basis to multiple the required number of S- relays, in groups of four relays, to each set of 12 SC- points. In offices with relatively few classes, it is probably desirable to order one S- relay per class. In offices with more complex service treatment patterns, substantial reductions in the number of relays are often possible by use of group sort treatments. The "sort" arrangement in the marker basically provides either two or four separate output points (SWC- punchings for each class of service).

In other words, one class of service may operate up to four S- relays (SFD-E124). The SC- points for which treatments are variable from class to class, with no particular pattern must be handled on an individual treatment basis; one S- relay furnished per class of service, per 12 SC- points. The SC- points for which two or more classes of service are always treated alike, may be served on a group sort basis; one relay may represent several classes for this group of SC- points.

E1-5.2 PREROUTE RELAYS

A preroute relay is considered an auxiliary to the route relay and provides extra contacts, not available on the route relay, for other functions. Examples of preroute relays and their functions are LPA and LPB, DRO-3, and OPSO and 1 as explained below.

E1-5.2.1 LPA or LPB Local Physical Office A or B Relays (SFD-E126)

The SFD-E126 shows typical route relay operations. One example uses preroute relays LPA and LPB, local physical office A and B. This informs the marker that the call terminates within the marker group. When the code point C765 or C766, of this document, is grounded, the local completion relays LPA or LPB operates. This operates the desired route relay on ITR calls.

E1-5.2.2 Diverted or Denied Route Relays (SFD-E127, E128)

The DRO-7 (diverted route), relays may be arranged to deny service to certain classes of customers (such as PBX lines not allowed to place toll calls). On diverted service the S- points connect to a DRO-7 relay (SFD-E127) which prevents the R- route relay from operating because of the high resistance winding of the DR- relays but the DR- relay will operate. The operation of the DR- relay acts as a preroute to operate the desired route relay for the route assigned to the customer who is being denied access to the route requested.

E1-5.2.3 Operator Routes (SFD-E128)

The OPSO and 1 relays are preroute relays and are provided on operator routes when the marker is required to pass a class signal to the trunk over the "TC" lead. The signal usually results in a tone signal to the operator which indicates the class of the calling customer. There are other preroute relays not covered by this SCD but can be found in CD-26002-01 Section II.

E1-5.3 ROUTE SERIES

The route relay does not furnish the information as to what charge condition is to be met in the trunk, the call is free (flat rate), or a message register must be operated, etc. This is accomplished by inserting a route series relay between the route relay and battery. These route series relays (NCNC, MBS-) appear on the translator and code treatment frame.

E1-6 TYPICAL ROUTE RELAY OPERATIONS

The SFD-E122-E132 shows a few typical route relay operations. The purpose is to give the craft person an overview of screening and route relay operation. The SD-26002-01 Section D Note 400 series illustrates many more typicals. The examples above may be used in the established format by the operating company or may vary depending on the complexity of their routes. In all cases, the office cross-connect records should be examined to determine the local assignments. Two examples of route relay operation will be demonstrated.

Example #1, assume a call originates from the 765 office (office A) to the 253 office in the same area code and the class of service is 1 party flat rate (1F). The operation of the route and route series relays is as follows: The service treatment relay (S28) operates per the table on SFD-E125. Ground on code point, C253 (SFD-E127), extends from C253 to the SC12 punching, to the USC0 punching, through the S28 1M, to the S28 punching, to the SG13 punching, to the RC30 punching, through the route relay R30, to the R30 punching, to the NN punching through the non-charge-non-coin (NCNC) relay, to the route series battery. This operates the route and route series relays.

Example #2, assume a call originates from the 766 office (office B) to the 222 office in the same local area code and the subscriber class of service is 2-party message rate (2MR), the operation of the route and route series relays is as follows. The service treatment relay (S38) operates per the table on SFD-E125. Ground on code point C222 (SFD-E127) extends from C222 to the RC32 punching, through the route relay, R32, to the R32 punching, to the SC14 punching, to the USC2 punching, through the S38 3M, to the S38 punching, to the MBS1 punching, through the message billing series (MBS1) relay to the route series battery to operate the R32 and MBS1 relays.

E1-7 INFORMATION TRANSMITTED THROUGH CONTACTS OF THE ROUTE RELAYS,
R--- AND FC--- (SFD-E117)

The route relay controls the marker functions required for trunks and senders. Service cross-connects in the CM and TL permit the information controlled by a route relay to vary, depending on the office requirements. The R--- (route relay), provides 30 make contacts. The FC--- (frame test lead cut-in), relay is an additional route relay required in offices having more than 20 trunk link frames. When the FC--- relay is provided it operates in parallel with the route relay. Functionally, the FC---relay may be considered as part of the route relay. The FC--- relay provides 12 make contacts. The assignment of contacts for the R and FC relays is shown in table A on the next page.

TABLE A
ROUTE RELAY CONTACT ASSIGNMENT

RELAY	CONTACT	TERMINAL DESIGNATION	RELAY	CONTACT	TERMINAL DESIGNATION
R000-R399	00	TB-	R000-R399	33	FTC 8
R000-R399	10	OS-	R000-R399	43	FTC 13
R000-R399	20	DL-	R000-R399	53	FTC 18
R000-R399	30	FTC 5	R000-R399	04	OF-
R000-R399	40	FTC 10	R000-R399	14	FTC 1
R000-R399	50	FTC 15	R000-R399	24	FTC 4
R000-R399	01	TG-	R000-R399	34	FTC 9
R000-R399	11	CL-	R000-R399	44	FTC 14
R000-R399	21	CP-	R000-R399	54	FTC 19
R000-R399	31	FTC 6	FC000-FC399	1	FTC 20
R000-R399	41	FTC 11	FC000-FC399	2	FTC 21
R000-R399	51	FTC 16	FC000-FC399	3	FTC 22
R000-R399	02	RA-	FC000-FC399	4	FTC 23
R000-R399	12	CR-	FC000-FC399	5	FTC 24
R000-R399	22	FTC 2	FC000-FC399	6	FTC 25
R000-R399	32	FTC 7	FC000-FC399	7	FTC 26
R000-R399	42	FTC 12	FC000-FC399	8	FTC 27
R000-R399	52	FTC 17	FC000-FC399	9	FTC 28
R000-R399	03	PC-	FC000-FC399	10	FTC 29
R000-R399	13	FTC 0	FC000-FC399	11	FCK 3
R000-R399	23	FTC 3	FC000-FC399	12	Operate XFC REL.

E1-8 OPERATION OF THE CKG1,2; LLC1,2,3; ONX, TLC1,2, AND BX RELAYS

To provide a large number of off-normal grounds and battery potentials to the marker circuit and to interconnect certain functional units, the CKG1,2 4-6; LLC1,2,3; and TLC1,2 relays will be operated.

The operation of the ORMC MA- through ME- relays will extend ground to the CKG lead and will operate the CKG1,2,4,5,6 relays in the marker (SFD-E108, E121). The CKG- relays provide off-normal grounds.

The CKG2 relay in operating will operate the BX relay (SFD-E109). The CKG1 relay in operating will operate the ONX relay (SFD-E108). The BX relay provides bias for some of the cross-detecting relays, while the ONX relay provides means for testing for crosses on the select magnet leads.

The operation of the CKG2 relay will operate the TLC1,2 relays (SFD-E121). The TLC1,2 relays provide battery potential for operating the trunk link connector cut-through relays and other miscellaneous off-normal ground and battery functions.

The operation of the CKG4 relay will operate LLC1 relay which in turn operates the LLC2 and 3 relays (SFD-E121). The LLC1,2 and 3 relays operated provides battery potential for seizing the line link frame and operating the line link connector cut-through relays. The LLC1,2, and 3 relays also provide other miscellaneous battery and grounds.

The operation of the LLC1 relay will operate the GC or, if provided, GCA relays which provide junctor group control functions (SFD-E525).

E1-9 ROUTE RELAY FUNCTIONS (SFD-E117)

When the route relay operates, ground is extended through the route relay to operate information relays that will be used to complete the call. They are FTC 0-29, TB 0-5 (TBO-9), TG 0-9, RA1-6 and NSI.

E1-9.1 FTC 0-29 RELAY OPERATIONS (SFD-E117)

When the route relay operates, the marker determines which trunk link frame has at least one usable trunk available by closing ground to operate a FTC-, frame test common, relay.

E1-9.2 TBO-5 (SD-26032-01) OR TBO-9 (SD-27879-01), TBO-9 AND TGP OR TGS

Trunks are located in terms of trunk block and trunk group. When the route relay operates, ground is extended through its make contact to operate the TBO-5 (TBO-9) trunk block; TGO-9, trunk group and TGP, trunk

group primary or TGS, trunk group secondary, relays. The TB- relay in the marker operates the TB- relay in the TL to cut through all BT00-19 leads associated with the trunk block. The TG- relay, with the TGP or TGS, cuts through a TG- lead to test all idle trunks of a particular route.

E1-9.3 RA- ROUTE ADVANCE (SFD-E117)

The RA- relay is operated in series with the TB- relay after the operation of the R- relay. In the event the CM cannot find an idle trunk or channel, the call will route advance. When the RAV1,2 (SFD-E517) relays operate they cause the operation of one GS- (SFD-E519) relay that supplies ground to the operated R- relay. All of the relays that were previously operated by the operation of the R- relay now release. The GS- relay and the R- relay do not release. The RAV1,2 relays lock operated to the SNK relay. The SNK relay will release and release the RAV1,2 relays when the marker has been reset and is ready to operate another R- relay or take action as determined by the cross-connections to the RA- terminal of the R- relay.

E1-9.4 NSI - NO SENDER INTRAOFFICE (SFD-E126)

The NSI (no sender intraoffice) relay operates through the cross-connect information of the operated R- relay and the operated FSA (SFD-E121) relay. The operated NSI relay allows the ITR1,2 (intra-office class) relays and the FLG,1 (forward linkage ground) relays to operate.

SECTION E, PART 2

CONNECTION TO A TRUNK LINK FRAME AND TRUNK

Index

		<u>PAGE</u>
E2	CONNECTION TO A TRUNK LINK FRAME AND TRUNK	E2-2
E2-1	TRUNK LINK FRAME SELECTION	E2-2
E2-1.1	TEST FOR IDLE TRUNKS ON TRUNK LINK FRAMES	E2-2
E2-1.2	TRUNK LINK FRAME BUSY TEST	E2-2
E2-1.3	TL PREFERENCE ORDER OF SELECTION CONTROLLED BY MEMORY OF PREVIOUS SELECTED TL	E2-2
E2-1.4	FRAME SELECTION, OPERATION OF THE FS0-29 RELAYS	E2-3
E2-1.5	TRUNK LINK FRAME SEIZURE	E2-3
E2-1.5.1	Preference Control Circuit	E2-3
E2-1.5.1.1	MP - Relay Operate Chain	E2-4
E2-1.5.1.2	MP - Relay Work Chain	E2-4
E2-1.5.1.3	Emergency Transfer (SFD-E206)	E2-4
E2-1.5.1.4	Manual Transfer	E2-5
E2-1.5.1.5	Frame Busy Signal (SFD-E204, E205)	E2-5
E2-1.6	RECYCLE OF FRAME MEMORY PREFERENCE	E2-6
E2-2	TEST AND SELECTION OF AN IDLE TRUNK	E2-6
E2-2.1	TRUNK BLOCK AND TRUNK GROUP CONTROL	E2-6
E2-2.2	CROSS CONNECT OF THE TG- to F- PUNCHINGS	E2-7
E2-2.3	BTO-19, BUSY TEST, LEADS	E2-7
E2-2.4	OPERATION OF THE TB- RELAY IN THE TRUNK LINK; THE TBK, TRUNK BLOCK CHECK, AND THE TSE 1,2, TRUNK SELECT END, RELAYS IN THE MARKER	E2-7
E2-2.5	OPERATION OF THE TTO-9 RELAYS	E2-7
E2-2.6	OPERATION OF THE TSO-9 RELAYS AND RELEASE OF THE TSE1,2 AND TTO-9 RELAYS	E2-8
E2-2.7	OPERATION OF THE OTS AND OT OR THE ETS RELAY	E2-8
E2-2.8	SEIZURE OF THE TRUNK AND OPERATION OF THE F RELAY IN THE TRUNK	E2-8
E2-3	OPERATION OF CONTROL RELAYS IN THE TL FRAME	E2-8
E2-4	TRUNK CLASS CONTROL AND TRUNK CHARGING (SFD-E212)	E2-9
E2-5	TRUNK BUSY TIMING	E2-9

E2 CONNECTION TO A TRUNK LINK FRAME AND TRUNK

A TL (trunk link) is selected containing an idle ITR (intraoffice) trunk by testing the FTC- leads, and the trunk is selected according to TB- and TG- information contained in the operated route relay.

To permit selection by the CM, the outgoing end, or CB stage, required a TB relay and therefore is assigned to the A appearance of the TL. The incoming end, or FLG stage, required a RSW (ring selection switch) and is assigned to the B appearance. Both appearances of a ITR trunk are assigned to the same TL and the same level. The B appearance is one switch number higher than the A appearance on the TL.

E2-1 TRUNK LINK FRAME SELECTIONE2-1.1 TEST FOR IDLE TRUNKS ON TRUNK LINK FRAMES (SFD-E204)

The completing marker determines which trunk link frames have at least one usable trunk when it operates a route relay. All trunks of the same route on a trunk link frame have the FT leads multiplied together and cross connected to the FTC (frame test common) terminal for that particular route. At the trunk link end, the FTC lead corresponds to the route relay number. At the marker end, the FTC lead corresponds to the trunk link frame number. The operated route relay closes through individual FTC leads to each trunk link. If at least one trunk is idle, ground from the trunk will ground the associated FTC lead and operate an associated FTC relay in the marker. The FTC leads are used in common by the markers, and one or all markers can connect to the same FTC lead at the same time.

E2-1.2 TRUNK LINK FRAME BUSY TEST

To prevent marker delays, it is necessary to determine which TLs are being used by other markers. The operation of the BCO (busy cut-in), BC10, and BC20, (busy cut-in auxiliary) relays extends the windings of the FB029 (frame busy) relays to the associated TL to check if the frame is busy. If the TL is busy, the associated FB- relay operates. To select a TL, the associated FTC relay must be operated while the FB- relay is non-operated.

E2-1.3 TL PREFERENCE ORDER OF SELECTION CONTROLLED BY MEMORY OF PREVIOUSLY SELECTED TL

Frame memory relays have been provided to equalize traffic to the trunk link frames. The FMG (frame memory group) relay and the FM- (frame memory) relay will be held operated from the previous call to record the identification of the TL used in that connection. This information is locked in the marker and on the next call will be used to make the succeeding TL first choice for the marker. However, if the first choice TL is not available for service, the next preferred TL is selected.

As described in E2-1.6, after the TL has been selected, the frame memory relays which have been locked operated to identify the last TL used are released. The frame memory relays identifying the TL used in this connection are then operated.

E2-1.4 FRAME SELECTION, OPERATION OF THE FSO-29 RELAYS

The operation of a FSO-29 (frame select), relay indicates the TL to be selected to complete this connection. The operation of the FS- relay depends on:

- (a) The operation of the FTC- relay with the associated FB- relay nonoperated, indicating an idle TL with an idle trunk of the desired type.
- (b) The setting of the FMG- and FM- relays.
- (c) The operation of the FMG relay indicating that the frame memory relays have been held operated from the previous call.

The FS- relay which operates will generally be associated with the second higher numbered frame than the frame recorded on the frame memory relays. The reason for advancing the frame selection in steps of two is in the event of paired trunk links where all channels are busy and the marker is recycled, it will always be advanced to a different TL. This prevents the marker from staying in the same TL and allows another set of junctors to be tested.

E2-1.5 TRUNK LINK FRAME SEIZURE (SFD-E205)

Operation of an FS- relay closes start battery to the preference control circuit associated with the trunk link frame having the same number as the operated FS- relay.

E2-1.5.1 Preference Control Circuit

The preference control circuit associated with trunk link connectors provides two preference relays MP (marker preference) and E (emergency marker preference) per marker for each trunk link connector. There is means for detecting trouble associated with both the MP- and E- relays and for automatically switching from one to the other in the event of detected trouble. The MP- relays are interconnected by three chain circuits which enable connection of one marker at a time to a trunk link frame. Similar independent chains interconnect the E- relays. While the following description is for MP- relays, it applies equally to the E- relays.

E2-1.5.1.1 MP - Relay Operate Chain (SFD-E206)

In periods of very light traffic (assuming only one marker at a time applies start battery to bid for seizure of a TL), MP- relay operation is straightforward. A start signal battery from a marker is applied to the associated MP- relay winding which is connected through the MP- operate chain to ground at the winding of the first relay in the operate chain. In periods of heavy traffic, two or more markers may initiate requests either simultaneously or in rapid succession.

Assume that the first and last markers in the preference chain initiate simultaneous request for connection to the same TL. Both MP- relays will operate and lock. If, however, the last marker has initiated a request slightly before the first marker, the MP- relay for the first marker could not have operated because ground for its winding would have been opened by the operate chain at the MP- relay for the last marker. On the other hand, if the first marker initiated a bid first, any other marker ahead of it in the operate chain could subsequently operate its MP- relay.

E2-1.5.1.2 MP - Relay Work Chain (SFD-E206)

Since it is possible to operate two or more MP- relays at the same time, two work chains determine which MP- relay does the work. The work chains progress through contacts of the MP- relays in the opposite direction to the operate chain, starting with ground at contacts of the MP- relay for the first marker. If the MP- relay for the first marker is operated, one work chain ground will operate the M trunk link connector relay whether or not other MP- relays are operated. The M relay operates other connector relays by closing through battery supplied by the marker.

The second work chain grounds the CK lead to the marker which has gained access to the trunk link frame to operate the TFK1-2 (trunk frame check) relays in the marker. The TFK1 relay provides a locking ground for the FS relay which had closed through the start battery to the preference control circuit. The TFK1 relay also opens the ground from which the FS relay had operated. When the marker which has seized the TL has finished its job and opened the start lead to the preference control, its MP relay is released. If there are any other operated MP relays, the next MP relay in the work chain which is operated will function as just described. This procedure continues until all operated MP relays have been served.

E2-1.5.1.3 Emergency Transfer (SFD-E206)

Two sets of preference relays MP and E are provided in the preference control, either of which can perform the preference job while the other serves as a standby. The CH relay provides trouble detection on the active set of preference relays by monitoring the operate chain and one of the work chains. Assume that the TR key and TR- relay are normal so

that MP relays are active. When all MP relays are normal, ground through all the break contacts of the operate chain is connected to one side of the CH relay winding, and ground through all the break contacts of the work chain which operated connector relays is connected to the other side. The CH relay cannot operate with ground on both sides of its winding. When one or more of the MP relays operate, both preference chains are opened to remove ground from both sides of the CH relay winding leaving resistance battery connected to both sides of the winding. Again, the relay cannot operate. If, however, all break contacts of either chain do not conduct, or if a wire is broken when the MP relays are all normal, one side of the CH relay winding will have ground and the other resistance battery which will operate the CH relay. Also, if any of the break contacts fail to open or if there is a false ground on either chain when one or more MP relays operate, the CH relay will again have resistance battery on one side of its winding and ground on the other and will operate.

If the CH relay operates, even momentarily, the TR relay operates and locks. The TR relay operates TR- relays which transfer the SF, CK, and MC leads from MP relays to E relays. The TR relay also brings in a minor alarm and lights a CH lamp.*

The alarm can be restored by momentarily operating the AR key located at the frame or can be restored remotely via the alarm sending circuit. Release of the alarm also restores operation to the MP chain if the TR key is normal or to the E chain if the TR key is operated.

E2-1.5.1.4 Manual Transfer (SFD-E206)

By operating the TR key, located at the TLCC (trunk link connector control frame), preference control can be manually transferred from the MP to the E relays. The TR key operates the TR- relays which remain operated to accomplish the transfer as described previously. The TR key also connects the CH relay to chains of the E relays. If the CH relay operates, it operates the TR relay which locks and releases the TR- relays to transfer preference back to the MP relays.

E2-1.5.1.5 Frame Busy Signal (SFD-E204, E205)

When the trunk link connector relays operate, they ground FB leads to all markers as an indication that the trunk link frame is now busy. In all markers except the one that seized the TL, operated FB relays cause the release of associated FS relays (if operated) and operation of another FS relay (assuming another FTC relay is operated with a normal FB relay). In the marker which had seized the TL, the locking ground from the operated TFK1 prevents release of the FS relay. The operated TFK1 also prevents operation of any other FS relay by its removal of the

* Although the CH lamp is shown as part of the trunk link connector circuit, it and the alarm release key are located on a frame designated as "trunk link connector control".

operate ground for FS relays. Thus, any other markers establishing intraoffice connections will remove their bid for the particular TL and possibly bid for another which had idle trunks. As described in SCD Section D, completing markers handling incoming trunk calls can only go to one TL and will continue their bid for the same TL.

E2-1.6 RECYCLE OF FRAME MEMORY PREFERENCE (SFD-E207)

After the trunk link frame has been seized, the marker resets the frame memory relays. The operation of relay TFK1 removes the locking ground from relays FM- and FMG- held from the previous usage, thereby allowing them to release. The release of relays FM- and FMG- releases relay FMK, frame memory check, which releases relay FMG. The release of relay FMG, together with the operated relays FS, TFK1 and TFK2 on this usage, operates the FM- and FMG- relays that correspond to the trunk link frame being used. Relay FMK reoperates. Because relay TFK1 is operated, relay FML (frame memory lock) operates and relay FMG remains nonoperated and provides a locking ground for the FM- and FMG- relays. The operation of relay FML releases relay BCO, 10, and 20, opening the trunk link frame test leads and releasing the operated FB relays. The FML relay operated opens a break contact in the FMK (frame memory check) relay circuit. This now ensures that the FMK relay will remain operated only when both FM- and FMG- relays are operated. The FMK and FML relay operation is represented on the trouble record card by progress punch FML. Failure to lock the new frame memory relays will be detected at the time the marker prepares to operate the disconnect relays DIS1 and 2, disconnect, relays through make-contacts of the FML and FMK relays (SFD-E806). A trouble record will be produced showing no FML punch.

E2-2 TEST AND SELECTION OF AN IDLE TRUNK (SFD-E208, E209)

As soon as the trunk link frame is seized, the marker proceeds to test and select an idle trunk. The various steps are as follows.

E2-2.1 TRUNK BLOCK AND TRUNK GROUP CONTROL

Most trunk link frames (SD-26032-01) have ten level crossbar switches which provide a total of 160 trunk terminations of which no more than 120 can be seized by the completing or dial tone markers. Each group of trunks or originating registers is assigned one of six TB- (trunk block) numbers and are of 20 TG (trunk group) numbers for a maximum total of 120 routes.

The marker indicates which TB- and TG- relays will be used by operating its route relay. The marker identifies a particular route by placing a battery on the TB- lead and ground on the TG- lead. The battery on the TB- lead operates a TB- relay in the trunk link frame. The operation of the TB- relay in the TL cuts through 20 BT leads, BT00-19 to the completing marker to battery.

E2-2.2 CROSS CONNECT OF THE TG- TO F- PUNCHINGS (SFD-E209)

Each trunk has an F lead. This lead is connected to an F punching at the TL. All these F punchings, for trunks which have the same TG- number, are connected to the corresponding TG- punching.

E2-2.3 BT00-19, BUSY TEST, LEADS (SFD-E209)

In the trunk, each F lead is connected through an F relay winding (through contacts which are open while the circuit is busy) and then to a BT punching. In testing for an idle trunk, the marker grounds one TG lead. This results in the grounding of the F leads of all trunks of the desired route as well as those of other routes of the same TG-number. The marker also operates the TB- relay corresponding to the TB- number of that route. Only BT- leads corresponding to trunks of the desired route will have resistance ground on them because the TB- relay selected only those with the proper TB- number and the TG- lead provided ground to only those of the proper TG- number.

The TB- relay connects 20 BT leads into the marker. Any number of the BT00-19 leads may be assigned to one route. However, it should be noted that some of the routes may be unavailable because all of the BT- leads may be in use for other routes. For example, suppose that a route in TB3 has 18 trunks associated with it on one trunk link frame, then there will be only 2 BT- leads left for the other routes in TB3. Consequently, only a maximum of three routes out of twenty can be used on TB3, on that frame.

E2-2.4 OPERATION OF THE TB- RELAY IN THE TRUNK LINK; THE TBK, TRUNK BLOCK CHECK, AND THE TSE 1,2, TRUNK SELECT END, RELAYS IN THE MARKER (SFD-E208, E209)

To check that the TB- relay operates in the TL, ground is extended back to the marker on the TBK lead to operate the TBK (trunk block check) relay. When the TLC1,2 (trunk link control) relays operate they permit the marker to determine that none of the TS- (trunk select) relays are operated by the operation of the TSE1,2 relays. The operated TSE2 relay provides the battery for operating the TT0-9 (test trunk) relays.

E2-2.5 OPERATION OF THE TT0-9 RELAYS (SFD-E209)

The TT0-9 relays are double wound with each winding being connected to one of the BT00-19 leads. An idle trunk is indicated by the operation of a TT- relay. The operation of any TT- relay does not alone indicate the particular trunk that is idle. The marker must determine which one of the two is grounded with an odd and even preference lockout circuit.

E2-2.6 OPERATION OF THE TS0-9 RELAYS AND RELEASE OF THE TSE1,2 AND TT0-9 RELAYS (SFD-E208, E209)

After the TLC1, TSE1, TBK and MAK1 relays operate, ground is extended through the marker junctor sequence circuit to operate the TS0-9 (trunk select) relays. The operated TS- relay locks under control of the TLC1 relay and releases the TSE1,2 relays. The TSE2, in turn, releases the TT0-9 relays. With the operation of the TS- relay, marker selection of a trunk is directed to one of the two trunks which appear on a particular TS- relay. These leads, which indicate idle trunks when grounded, are extended to an OTS (odd trunk selection) or ETS (even trunk selection) relay to permit selection of one of the two trunks.

E2-2.7 OPERATION OF THE OTS AND OT OR THE ETS RELAY (SFD-E209)

The ETS and OTS relays are double wound polar relays. The current through the primary winding is in a direction to operate the relays, and the current through the secondary windings is in a direction to hold the relay non-operated. When both windings are energized, the current through the bias, secondary, winding is sufficient to hold the relay non-operated.

The TZ, trunk preference (Z), relay is used to change preference on each marker usage.

If the TZ relay is non-operated, the bias winding of the ETS is opened. Therefore, with ground on both the odd and even BT- leads the ETS relay operates and the OTS relay is biased non-operated. However, if the TZ relay is operated, the OTS bias winding is open and the OTS and OT relays operate.

E2-2.8 SEIZURE OF THE TRUNK AND OPERATION OF THE F RELAY IN THE TRUNK (SFD-E209)

The busy test (test for idle trunks) is made with high resistance TT-relays. The F relay of the trunk does not operate in series with the TT- relay. The operation of the OTS or ETS relay changes the high resistance to a low resistance, which locks the OTS or ETS operated and operates the F relay in the trunk.

E2-3 OPERATION OF CONTROL RELAYS IN THE TL FRAME (SFD-E211)

When the F relay in the trunk is operated, it operates an FA- and FB-relay. The FA- and FB- then operates a LV0-9 (level connector) relay. There is one of these relays associated with each of the levels (horizontal) of the trunk switches.

With the operation of the FA-- and FB-- relays, one LV- relay operates. Several leads are connected to the marker through the TLC as follows:

- (a) The FBK informs the marker that the B appearance of the trunk is in use and checks the operation of the FB relay.
- (b) The FAK informs the marker that the A appearance of the trunk is in use and checks the operation of the FA relay.
- (c) The BST and AST connects the crosspoint sleeve into the marker for test purposes when cross points are being set up.
- (d) The BSM and ASM connects the associated directing and trunk select magnets into the marker.
- (e) The BLC and ALC connects an operating circuit, for the LC relay associated with the trunk switch in which the trunk appears, into the marker.

The marker uses the LVK lead to check that only one LV- relay operates.

As soon as the FA- and FB- relays operate, they operate an LC- relay. The LC is associated with a trunk switch and it grounds the LCK lead to enable the marker to check its operation and in conjunction with R (right side of frame), and L (left side of frame), relays connect ten links of the associated switch into the marker for channel test purposes (SFD-E502).

E2-4 TRUNK CLASS CONTROL AND TRUNK CHARGING (SFD-E212)

As previously shown, a route relay may be associated with various route series relays to control the transmission of trunk class information to the trunks.

The marker insures that the trunk class signals are locked in the trunk when making the linkage check by checking the operation of either the NOC (no class transmitted) or the CLK (class check) relays.

E2-5 TRUNK BUSY TIMING (SFD-E210)

The trunk busy test timer starts where the marker begins testing the trunk group for an idle trunk. If the marker does not detect a TL with an idle trunk within 27.5 to 30.5 milliseconds on service calls or 79.5 to 95.5 milliseconds on test calls, the TBT (trunk busy timing) relay operates to indicate an all trunks busy condition.

The trunk busy test timer is started by seizure of the trunk link frame and operation of the TBK (trunk block check) relay. If a trunk is not selected, the TBT relay operates to indicate all trunks busy when the TA (trunk available) relay is released, or an open BT or TG lead, if the TA relay is operated. If the TA relay is operated a trouble record is requested on first trials and a route advance on second trials.

SECTION E, PART 3

CONNECTION TO THE NUMBER GROUP FRAME

Index

	<u>PAGE</u>
E3 CONNECTION TO THE NUMBER GROUP	E3-2
E3-1 CAPACITY OF THE NUMBER GROUP	E3-2
E3-2 NUMBER SERIES START, NSS0-5	E3-2
E3-3 OFF NORMAL CONTROL	E3-3
E3-4 PREFERENCE CONTROL CIRCUIT	E3-3
E3-4.1 MP- RELAY OPERATE CHAIN	E3-4
E3-4.2 MP- RELAY WORK CHAIN	E3-4
E3-4.3 EMERGENCY TRANSFER	E3-4
E3-4.4 MANUAL TRANSFER	E3-5
E3-5 NUMBER GROUP TRANSLATION	E3-5
E3-5.1 HUNDREDS BLOCK, HB0-9	E3-6
E3-5.1.1 Rate Treatment Discrimination (Physical, Theoretical, and Extra-Theoretical Numbers)	E3-6
E3-5.2 TENS BLOCK, TB00-99	E3-6
E3-5.2.1 Tens Block Screening	E3-6
E3-5.3 UNITS NUMBER, U0-9	E3-7
E3-5.4 TRANSLATED INFORMATION PASSED TO THE COMPLETING MARKER	E3-7
E3-6 INTERCEPT TREATMENT	E3-8
E3-6.1 BLANK NUMBER AND REGULAR INTERCEPT	E3-8
E3-6.1.1 Called Number Associated with Unequipped Number Group	E3-9
E3-6.1.2 Called Number Associated with Blank Hundreds Group	E3-9
E3-6.1.3 Called Number is a Changed or Disconnected Number or is an Individual Blank Number that is Treated as a Disconnected Number	E3-9
E3-6.1.4 Called Number is an Individual Blank Number that is Treated Differently from a Disconnected Number	E3-10
E3-6.1.5 Called Number is an Individual Number that is Temporarily Disconnected	E3-10
E3-6.1.6 Physical and Theoretical Match	E3-10
E3-6.2 TROUBLE INTERCEPT CONNECTION	E3-10
E3-6.2.1 Call to a Non-PBX Number	E3-11

E3 CONNECTION TO A NUMBER GROUP

Since the called number does not directly indicate the called line equipment location, a NG (number group) is called in to translate the called number into its equipment location on the LL (line link). This location is by FTT- (frame tens), FUT- (frame units), VGT- (vertical group), HGT- (horizontal group), and VFT- (vertical file). A ringing combination code is also received to control proper ringing for a particular called line.

On TER calls, before seizing the NG, the marker must seize a TL. On ITR calls, the marker attempts to seize a NG at the time a TL seizure is attempted. If the marker fails to obtain a TL before completing its NG seizure, the NG is released for use by other markers and the marker awaits a TL seizure before attempting another NG seizure. This permits a savings of marker holding time by permitting the marker to attempt NG and TL seizure at the same time.

E3-1 CAPACITY OF THE NUMBER GROUP

The No. 5 crossbar marker group is equipped for a maximum of 40,000 numbers (directory and trunk) arranged for six number series, as follows:

Number Series Group A

No. Series 0
No. Series 2
No. Series 4

Number Series Group B

No. Series 1
No. Series 3
No. Series 5

Each 1000 directory numbers comprise a number group. A marker group can accommodate 40 such number groups or a total of 40,000 directory numbers including trunk numbers. Number groups are provided to fill the needs of the respective number series and should be considered as independent of number series groups. The frames are numbered as they are added from 00 through 39.

E3-2 NUMBER SERIES START, NSSO-5 (SFD-E305)

The number series start relays are used to direct the completing marker to a start lead to seize a number group frame.

Ground is extended through the relays in the completing marker associated with the directory number of the called customer to be translated. This is a check that the 2-out-of-5 relays have operated which are the U2/5, T2/5, HN2/5, and TH2/5. The ground also extends through local completion relays, through a cross-connect to operate a NSS- relay.

When the FS- and ITR1 relays operate, battery is extended through the normal SP relay, the operated TLC2, FS-, FSA, ITR1, TH2/5 and NSS- relays to operate the MP- (marker preference) relay in the number group preference control and make-busy circuit operates (SFD-E307). This seizes the NGC (number group connector), which connects the marker to the NG by operating the connector multicontact relays. The connection to the NG by the marker is checked by the operation of the NGK and NGK1 relays and their associated punches.

In offices where unused hundred series of numbers exist in a number group, a second thousand series of numbers in the same office code group may be put into the NG to use the unused hundred series of numbers. In such offices, the ST- terminal associated with the added thousand series is cross-connected to the AS terminal and causes the operation of the AST (additional start), relay. Battery is then extended through the AST relay and an NSS- relay to an AST0-5 terminal, which is cross-connected to the ST- terminal of the NG containing the partially used series. The MP- relay associated with the marker then operates (SFD-E306, E307).

E3-3 OFF NORMAL CONTROL

The FLG relay operates the SNG1,2 relays. These relays control the operation of the MCB-MCE relays in the NGC (SFD-E306). After seizure of the NG the HT-, T-, U- digits of the called number are transmitted to the NG for translation. The NG translation operates the following CM relays for the called line location (SFD-E312), FTN- (frame tens number) FUN- (frame units number), VGN- (vertical group number, HGN- (horizontal group number), VFN- (vertical file number) and RCN- (ringing combination number). From this information the CM test relays FTT-, FUT-, VGT-, HGT-, VFT- (SFD-E315) and RCT- (SFD-E313) are operated. The test relays are locked operated to ground through their associated lock relays FTL, FUL, VGL, HGL, VFL (SFD-E315) and RCL (SFD-E313). CM relay LA (line auxiliary) SFD-E315 checks that the lock relays have operated. Before releasing the NG the CM checks for operation of relays VTK1, HTK1, FTK1, LA (SFD-E315) and RCL (SFD-E313).

E3-4 PREFERENCE CONTROL CIRCUIT (SFD-E307)

The preference control circuit associated with the number group connectors provides two preference relays MP- and E- (marker preference) per marker for each number group connector.

There is means for detecting trouble associated with both the MP- and E- relays and for automatically switching from one to the other in the event of detected trouble. The MP- relays are interconnected by three chain circuits which enable connection of one marker at a time to a number group frame. Similar independent chains interconnect the E- relays. While the following description is for MP- relays, it applies equally to the E- relays.

E3-4.1 MP- RELAY OPERATE CHAIN (SFD-E307)

In periods of very light traffic (assuming only one marker at a time applies start battery to bid for seizure of a NG), MP- relay operation is straightforward. A start signal battery from a marker is applied to the associated MP- relay winding which is connected through the MP- operate chain to ground at the winding of the first relay in the operate chain.

In periods of heavy traffic, two or more markers may initiate requests either simultaneously or in rapid succession.

Assume that the first and the last markers in the preference chain initiate simultaneous request for connection to the same NG. Both MP- relays will operate and lock. If, however, the last marker has initiated a request slightly before the first marker, the MP- relay for the first marker could not have operated because ground for its winding would have been opened by the operate chain at the MP- relay for the last marker. On the other hand, if the first marker initiated a bid first, any other marker ahead of it in the operate chain could subsequently operate its MP- relay.

E3-4.2 MP- RELAY WORK CHAIN (SFD-E307)

Since it is possible to operate two or more MP- relays at the same time, a work chain determines which MP- relay does the work. The work chain progresses through contacts of the MP- relays in the opposite direction to the operate chain, starting with ground at contacts of the MP- relay for the first marker. If the MP- relay for the first marker is operated, the work chain ground will operate the number group connector, MCA relay, whether or not other MP- relays are operated. The MCA relay operates the MCB-MCE relays by closing through battery supplied by the marker.

When the marker which has seized the NG has finished its job and opened the start lead to the preference control, its MP-relay is released. If there are any other operated MP- relays, the next MP- relay in the work chain which is operated now functions as just described. This continues until all operated MP- relays have been served.

E3-4.3 EMERGENCY TRANSFER (SFD-E307)

Two sets of preference relays MP- and E- are provided in the preference control either of which can perform the preference job while the other serves as a standby. The CH relay provides trouble detection on the active set of preference relays by monitoring the operate chain and one of the work chains. Assume that the TR key and TR relay are normal so that the MP- relays are active. When all MP- relays are normal, ground through all the break contacts of the operate chain is connected to one

side of the CH relay winding. The ground through all the break contacts of the work chain which operated connector relays is connected to the other. The CH relay cannot operate with ground on both sides of its winding. When one or more of the MP- relays operate, both preference chains are opened to remove ground from both sides of the CH relay winding leaving resistance battery connected to both sides of the winding. Again the relay cannot operate. If, however, all break contacts of either chain do not conduct, or if a wire is broken when the MP- relays are all normal, one side of the CH relay winding will have ground and the other resistance battery which will operate the CH relay. Also, if any of the break contacts fail to open or if there is a false ground on either chain when one or more MP- relays operate, the CH relay will again have resistance battery on one side of its winding and ground on the other and will operate.

If the CH relay operates, even momentarily, the TR relay operates and locks. The TR relay operates TR- relays which transfer the ST-, TMB, and MC leads from MP- relays to E-relays. The TR relay also brings in a minor alarm and lights a CH lamp.*

The alarm can be restored by momentarily operating the AR key located at the frame or can be restored remotely via the alarm sending circuit. Release of the alarm also restores operation to the MP- chain if the TR key is normal or to the E- chain if the TR key is operated.

E3-4.4 MANUAL TRANSFER

By operating the TR key, located at the connector control frame, preference control can be manually transferred from the MP- to the E- relays. The TR key operates the TR- relays which remain operated to accomplish the transfer as described previously. The TR key also connects the CH relay to chains of the E- relays. If the CH relay operates, it operates the TR relay which locks and releases the TR-relays to transfer preference back to the MP- relays.

E3-5 NUMBER GROUP TRANSLATION

After seizing the number group, the marker connects -48 volts through resistance lamps, to the hundreds, tens, and units leads, as determined by the operated HN-, TN-, and U- relays, to select one terminal from the 1000 sets of number terminals. The number group translates the directory number, represented by this one terminal, into line location and ringing combination and passes this information to the marker.

* Although the CH lamp is shown as part of the number group connector circuit, it and the alarm release key are located on a frame designated as "number group connector control."

E3-5.1 HUNDREDS BLOCK, HB0-9 (SFD-E308)

A HB0-9 relay in the NG is associated with the hundreds digit of the called number. Battery is extended to the NG over the HB0-9 leads associated with the HN2/5 relays to operate a HB0-9 relay in the NG.

E3-5.1.1 Rate Treatment Discrimination (Physical, Theoretical, and Extra-Theoretical Numbers) (SFD-E309)

The operation of the NG HB0-9 relay places ground on the PT cross-connection terminal associated with the HB relay. The cross-connections for the PT terminals are made in accordance with the cross-connection information shown in the NC. These cross-connections provide discriminating marks which are designated PN, TN, EN, and PTN or if the number is part of an added thousand series, the designations are PN1, TN1, EN1, and PTN1. If the PN1, TN1, EN1, or PTN1 terminal is grounded the marker compares this fact with the operated AST relay. If they do not agree, the blank number thousands relay operates. The information received from the number group (PN, TN, EN, or PTN), is matched against the local completion relay information which the marker used in selecting the NG. If a match is made, the PTK relay operates (SFD-E309).

E3-5.2 TENS BLOCK, TB00-99 (SFD-E308)

A TB00-99 relay in the NG (associated with the tens and hundreds digit of the called number), is operated to indicate the 100 groups of ten directory numbers in which the called number is located. The PN, TN, EN, or PTN relay closes battery to the NG over the one TBO-9 lead associated with the operated T2/5 relays. The TB- lead is extended in the NG through the HB- relay contacts to operate the one TB00-99 relay associated with the tens digit and hundreds digit of the called number. The marker TBW (tens block wetting) relay, operates in series with the NG TB- relay and checks that the operate path has been completed.

E3-5.2.1 Tens Block Screening Provided

When tens block screening is provided, cross-connections are made in the number group so that TBS1/4 relays in the number group operates in series with the TB-- relay. This indication is passed to the marker to operate the corresponding TBS- relay in the marker (SFD-E308). The particular TBS- relay that is operated can screen certain ringing combinations to give four different meanings to each ringing combination depending on the group of tens blocks in which the line is located.

E3-5.3 UNITS NUMBERS, U0-9 (SFD-E311)

A U0-9 relay in the NG is operated when the NGC relays close the U0-9 leads from the marker to the NG. Battery is closed through the operated U2/5 relays, and through the UC (units cut-in) relay, in the marker to one of the U0-9 leads to the NG. The operation of the NG U- relay extends ground over the UK lead to the marker, operating the UK (units check) relay, which checks that the NG units relay has operated.

E3-5.4 TRANSLATED INFORMATION PASSED TO THE COMPLETING MARKER (SFD-E312)

Each of the 1000 numbers in a NG has three terminals designated L, G, and F. Each of the 1000 numbers also has three separate fields of cross-connection terminals. These three fields consist of the LL, VHG, and RF terminals. The translator gives information about the called number over two sets of leads from each cross-connection.

The hundreds, tens, and units digit transmitted to the NG by the marker determine which set of L, G, and F terminals are connected to battery from the marker over the WL, WG, and WF leads.

The L terminal is cross-connected to an LL- terminal, which extends battery over the FT0-5 leads and FU0-9 leads to cause operation of the proper FTN0-5 (frame tens number) relay, and FUN0-9 (frame units number) relay in the marker.

The G terminal is cross-connected to a VHG- terminal, which extends battery over the HG0-9 leads and VG0-11 leads to cause operation of the proper HGN0-9 (horizontal group number) relay, and VGN0-11 (vertical group number) relay in the marker.

The F terminal is cross-connected to an RF- terminal, which extends battery over the RC1-15 and VF0-4 leads to cause operation of the proper RCN1-15 (ringing combination number) relay, and VFN0-4 (vertical file number) relay in the marker.

This information is then stored on the corresponding FTT-, FUT-, VGT-, HGT-, VFT-, and RCT- relays which lock through their associated FTL, FUL, VGL, HGL, VFL, and RCL relays located on SFD-E313, E315.

To check that the lock relays operate, the LA (lock auxiliary) relay operates in the marker (SFD-E315). To check that one and only one line location relay has operated, the HTK1, VTK1 and FTK1 relays operate and ground the associated punch (SFD-E315).

E3-6 INTERCEPT TREATMENT

The marker connects the calling line to intercept under the following conditions:

- (a) A blank number is called.
- (b) A changed or disconnected number is called.
- (c) A temporarily disconnected number is called.
- (d) A number associated with the line link appearance of a trunk is called.
- (e) The physical and theoretical match is not made.

The conditions listed above cause the operation of one of the intercept relays listed below:

- (a) BN - This causes the calling line to be connected to a no-such-number tone trunk or a machine intercept announcement.
- (b) RI - This causes the calling line to be connected to a regular intercept trunk.
- (c) OVC/PMO - This causes the overflow tone ringing condition to be set up on the ringing selection switch.

E3-6.1 BLANK NUMBER AND REGULAR INTERCEPT

Some of the intercept conditions listed above are enabled by removing one or more number group cross-connections as described in SCD-E3-6.1.4 and E3-6.1.5. In order to determine if intercept is required, the marker starts the TYM timing circuit when relay HTUK operates (SFD-E309). If the called number is not to be intercepted, it is translated, the number group released, and the TYM timer recycled before the end of the timing period. Under this condition the call proceeds in the usual manner. However, if the called number is to be intercepted, the TYM timer times-out and operates the TYM and TYMA relays (SFD-E309).

The operation of relay HTUK removes ground from the secondary winding of the TYM and the short circuit from the TYM1,2 capacitors. This permits the TYM1,2 capacitors to charge through the secondary winding of the TYM

relay and TYMO resistor. After an interval of time, the capacitor will be fully charged and the current flow through the secondary winding will cease. The TYM relay then operates on its primary winding in series with the TYM1 resistor.

The operation of relay TYM operates the TYMA relay, which extends ground through the nonoperated line identification relays to the intercept cross-connection terminals (SFD-E317).

E3-6.1.1 Called Number Associated with Unequipped Number Group

When the called number thousands digit represents an unequipped NG, the marker proceeds with its functions up to the selection and seizure of a NG. Then, when the marker extends battery to an ST- lead, a NG is not seized. The battery on this ST- lead is extended to the associated ST- cross-connection terminal. This ST- cross-connection terminal is cross-connected to the BNTH cross-connection terminal, thereby, extending battery to operate the blank number thousands or hundreds BNTH relay (SFD-E306, E309).

E3-6.1.2 Called Number Associated with Blank Hundreds Group

When the called number is one of a blank hundreds group, the marker proceeds until NG translation is required. Then, the operation of the number group HB- relay extends ground to the PT cross-connection terminal in the NG. When the hundreds group has only blank numbers, the PT cross-connection terminal is cross-connected to the BNK terminal in the NG, thereby, extending ground over the BNK lead to operate the BNTH relay in the marker (SFD-E309).

The operation of the BNTH relay extends ground to the BTI cross-connection terminal. These terminals are cross-connected to the BN, RI, or RO cross-connection terminals (SFD-E317).

E3-6.1.3 Called Number is a Changed or Disconnected Number or is an Individual Blank Number that is Treated as a Disconnected Number

When the called number is a changed or disconnected number, or is an individual blank number that is treated the same as a disconnected number, the marker proceeds with its functions until NG translation is required. However, in the NG, the cross-connections to the L-, G-, and F- cross-connection terminals for this called number are omitted. Therefore, the called line identification relays in the marker do not operate. The operation of the timer extends ground to the NI cross-connection terminal which is cross-connected to the appropriate intercept relay (SFD-E317).

E3-6.1.4 Called Number is an Individual Blank Number that is Treated Differently from a Disconnected Number

When the called number is an individual blank number or an unassigned number, and it is treated differently from a disconnected number, the marker proceeds with the connection until NG translation is required. In the NG, the cross-connections to the L- and F- terminals are omitted, but the G- terminal associated with the called number is cross-connected to the VHG- terminal. Battery is extended through the NG and operates the VGN- and HGN- relays in the marker. The VGN- and HGN- relays cause the VGL and HGL relays in the marker to operate as described in SCD-E3-5.4.

The TYM timing circuit functions as described. Upon timing out, the TYMA relay extends ground to the GI cross-connection terminal through the operated VGL and HGL relay contacts and the nonoperated VFL, RCL, FTL, and FUL relay contacts. This terminal is cross-connected to the RI or BN terminals depending on the type of intercept treatment desired (SFD-E317).

E3-6.1.5 Called Number is an Individual Number that is Temporarily Disconnected

When the called number is an individual number that has been temporarily disconnected, the marker proceeds with the connection until NG translation is required. In the NG the G- and F- cross-connection terminals are cross-connected to the VHG- and RF- terminals. The cross-connection to the L- terminal in the NG is omitted. Marker relays VGL, HGL, VFL, and RCL are operated as a result of these cross-connections in the NG and the FTL and FUL relays in the marker are nonoperated.

Since a complete NG translation cannot be made the TYM timer times-out and operates the TYMA relay. The TYMA relay causes ground to be extended through the operated VGL, HGL, VFL, and RCL relay contacts, and the nonoperated FTL and FUL relay contacts to the TI cross-connection to the RI or BN terminals for the desired intercept treatment (SFD-E317).

E3-6.1.6 Physical and Theoretical Match

If the physical and theoretical check between the trunk class or local completion relays and the output of the number group does not match, ground is placed on the NMI punching. This terminal is cross-connected for the desired intercept treatment (SFD-E307, E317).

E3-6.2 TROUBLE INTERCEPT CONNECTION

When the marker determines that a connection to the called number cannot be completed because the customer's line is out-of-service, the marker connects the calling customer to a trouble intercept trunk. The trouble intercept trunk connects the calling customer to an operator.

The trouble intercept trunks terminate on the LL. Therefore, in setting up a trouble intercept trunk connection, a connection is established from the LL associated with the trouble intercept trunk to the TL associated with the ITR or TER trunk.

E3-6.2.1 Call to a Non-PBX Number

If the call is for a non-PBX number, the line out-of-service is plugged-up on the MDF. When the line is plugged-up, battery on the ring conductor and ground on the tip conductor indicate to the marker that the call should be routed to a trouble intercept trunk.

SECTION E, PART 4
CONNECTION TO LINE LINK FRAME

Index

		<u>PAGE</u>
E4	CONNECTION TO LINE LINK FRAME	E4-2
E4-1	LINE LINK FRAME SEIZURE	E4-2
E4-1.1	PREFERENCE CONTROL CIRCUIT	E4-2
E4-1.1.1	MP- Relay Operate Chain	E4-2
E4-1.1.2	MP- Relay Work Chain	E4-3
E4-1.1.3	Emergency Transfer	E4-3
E4-1.1.4	Manual Transfer	E4-4
E4-2	LINE LINK FRAME CONTROL NONPAIRED OPERATION	E4-4
E4-2.1	CROSS DETECTION	E4-5
E4-3	PAIRED LINE LINK FRAMES	E4-5
E4-3.1	PAIRED LL FRAME AUXILIARY LL FRAME IDENTIFICATION	E4-5
E4-3.2	PAIRED LL FRAME MATE SEIZURE	E4-6
E4-3.3	PAIRED LL FRAME AUXILIARY LL CONTROL	E4-7
E4-4	PAIRED LINE LINK FRAME-MARKER GLARE CONDITION	E4-7
E4-5	PAIRED LL FRAME AUXILIARY LL-MAKE BUSY	E4-7
E4-6	CLASS-OF-SERVICE IDENTIFICATION	E4-7
E4-6.1	LINE LINK FRAME CROSS-CONNECTIONS	E4-8
E4-6.1.1	30 Classes-of-Service - Identification by Vertical File	E4-8
E4-6.1.2	60 Classes-of-Service - Identification by Vertical File	E4-8
E4-6.1.3	20 Classes-of-Service - Rate Treatment - Identification by Vertical File	E4-8
E4-6.1.4	100 Classes-of-Service - Identification by Vertical File	E4-9
E4-6.1.5	Identification of Class-of-Service by Hold Magnet	E4-9
E4-7	CONTROL OF CLASS-OF-SERVICE BY MASTER TEST CONTROL	E4-9
E4-7.1	30 OR 60 CLASSES-OF-SERVICE	E4-10
E4-7.2	60 CLASSES-OF-SERVICE	E4-10
E4-7.3	20 CLASSES-OF-SERVICE WITH RATE TREATMENT	E4-10
E4-7.4	100 CLASSES-OF-SERVICE	E4-11

E4 CONNECTION TO LINE LINK FRAME

The marker seizes the LL containing the called line in order to control selection of the line.

This connection is referred to as FLG (call forward linkage) and is on the "B" appearance of the trunk.

E4-1 LINE LINK FRAME SEIZURE (SFD-E402, E404, E405)

On ITR (intraoffice) calls, the seizure of the LL is made after the TL (trunk link) and NG (number group) have been selected. If trouble is encountered in the progress of the call, at this point, the CK punch will be an indication that the proper TL selection is made (SFD-E202). The NGK punch indicates the marker has seized the NG and operated its marker cut-in (MCA) relay (SFD-E302). The LFS battery from the CM is applied to the LL-ST lead through the operated LLC2, PTK, RCL, FLG1, FUT-, and FTT- relays in the CM to the ST- lead of the LLC-PC line link connector preference control circuit operating the MP- relay and associated LLC multicontact relays. The LFK punch is an indication that all LLC relays have properly operated.

E4-1.1 PREFERENCE CONTROL CIRCUIT (SFD-E405)

The preference control associated with the LLC provides two preference relays, MP- (marker preference) and E- (emergency) marker preference, per marker for each LLC. There is a means for detecting trouble associated with both the MP- and the E- relays and for automatically switching from one to the other in the event of detected trouble. The MP- relays are interconnected by two chain circuits, which enable connections of one marker at a time to an LL frame. Similar independent chains interconnect the E- relays. While the following description is for MP- relays, it applies equally to E- relays.

E4-1.1.1 MP- Relay Operate Chain

In periods of very light traffic (assuming only one marker at a time applies start battery to bid for seizure of a LL), MP- relay operation is straightforward. Start signal battery from a marker is applied to the associated MP- relay winding which is connected through the MP- operated chain to ground at the winding of the first relay in the operate chain. In periods of heavy traffic two or more markers may initiate request either simultaneously or in rapid succession.

Assume that the first CM and the first DTM initiate simultaneous request (apply start battery) for connection to the same LL. Both MP- relays will operate and lock. If, however, the first DTM had initiated a request slightly before the first CM, the MP- relay for the first CM could not have operated because ground for its winding would have been opened by the operated chain at the MP- relay for the first DTM. On the other hand, if the first CM initiated a bid first, any other marker ahead of it in the operate chain can subsequently operate its MP- relay.

E4-1.1.2 MP- Relay Work Chain

Since it is possible to operate two or more MP- relays at the same time, a work chain determines which MP- relay does the work. The work chain progresses through contacts of the MP- relays in the opposite direction to the operate chain starting with ground at a contact of the MP- relay for the first CM. If the MP- relay for the first CM is operated, the work chain ground will operate the M- LLC relay whether or not other MP- relays are operated. The M- relay operates other M- relays in the connector by closing through battery supplied by the marker.

When the marker which has seized the LL has finished its work and opened the start lead to the PC, its MP- relay is released. If there are any other operated MP- relays, the next MP- relay in the work chain which is operated, now functions as just described. This continues until all operated MP- relays have been served.

E4-1.1.3 Emergency Transfer

Two sets of preference relays (MP- and E-) are provided in the preference control, either of which can perform the preference job while the other serves as a standby. The CH relay provides trouble detection on the active set of preference relays by monitoring the operate chain and one of the work chains. Assume that the TR key and TR- relays are normal so that MP- relays are active. When all MP- relays are normal, ground through all break contacts of the operate chain is connected to one side of the CH relay winding, and ground through all break contacts of the work chain which operated connector relays is connected to the other. The CH relay cannot operate with ground on both sides of its winding. When one or more of the MP- relays operate, both preference chains are opened to remove ground from both sides of the CH relay winding, leaving resistance battery connected to both sides of the winding. Again, the relay cannot operate. If, however, all break contacts of either chain do not conduct, or if a wire is broken when the MP- relays are normal, one side of the CH relay winding will have ground and the other side will have resistance battery which will operate the CH relay. Also, if any of the break contacts fail to open or if there is a false ground on either chain when one or more MP- relays operate, the CH relay will again have resistance battery on one side of its winding and ground on the other side and will operate.

If the CH relay operates even momentarily, the TR relay operates and locks. The TR relay operates TR- relays which transfer the SF, CK-, and MC- leads from the MP- relays to E- relays. The TR relay also brings in a minor alarm and lights a CH lamp.

The alarm can be restored by momentarily operating the AR key located at the frame or can be restored remotely via the alarm sending circuit. Release of the alarm also restores operation to the MP- chain if the TR key is normal or to the E- chain if the TR key is operated.

E4-1.1.4 Manual Transfer

By operating the TR key, the preference control can be manually transferred for the MP- to the E- relays. The TR key operates the TR- relays which remain operated to accomplish the transfer as described previously. The TR key also connects the CH relay to chains of the E- relays. If the CH relay operates, it operates the TR relay which locks and releases the TR- relays to transfer preference back to the MP- relays.

E4-2 LINE LINK FRAME CONTROL NONPAIRED OPERATION (SFD-E407)

The marker obtains access to the LL frame through the preference control and make-busy circuit and LLC circuit.

On an FLG linkage, a translation is necessary from the number group to translate the called customers number into the line location on the LL. This location is registered on the FTT-, FUT-, VGT-, HGT-, and VFT-relays in the marker as shown on SFD-E315.

With the seizure of the TL and the information received from the NG, the marker can now close battery to the ST- lead to seize the LLC (SFD-E404, E405). The FTT-, and FUT- relays determine the LL, and the VGT-, HGT, and VFT relays determine the customers line location on a particular switch.

The marker will place HGB resistance battery on the HG- lead corresponding to the horizontal group number which it obtained from the NG. The operation of the MA1 relay in the LLC will extend the HG- lead to operate the HGA- and HGB- relays in the LL (SFD-E407).

The marker will place VGB resistance battery on the VGB- lead corresponding to the vertical group number which it obtained from the NG. The operation of the MA1 relay in the LLC will extend the VGB- lead to operate the VGB- relay in the LL (SFD-E407).

With the HGA-, HGB-, and VGB relays operated, a path is closed from the LG- relay to the BS lead. However, the BS lead does not have battery connected to it by the marker until the marker receives ground on the

HGK lead. The purpose of this is to insure closing the operating current of the LG- relay in the marker rather than through the HGA-, HGB-, or VGB- relay contacts so that protection can be provided on the basis of one per frame instead of one per LG- relay. The VGB- relay will operate before the closure of lead BS occurs.

E4-2.1 CROSS DETECTION (SFD-E407)

The marker employs the operate test to detect trouble on the HGA-, HGB-, LG-, or VGB- relays in the LL. If, for some reason, more than one HGA- or HGB- relay operated in the LL, the XHG relay would operate in the marker. This condition would stop progress of the call. The HGK punch would not be present on a trouble card.

If, for some reason, more than one LG- relay operated in the LL the XLG relay would operate in the marker. The operation of the XLG relay would produce the XLG trouble punch.

If, for some reason, more than one VGB- relay operated in the LL the XVGB relay would operate in the marker. The operation of the XVGB relay would extend ground to operate the XAVG relay in the marker and produce the XVGB trouble punch.

E4-3 PAIRED LINE LINK FRAMES

Paired line link operation is possible on all types of linkage except dial tone. Before paired line link operation can be applied to a marker group, the junctor groups must be wired as one of the following sizes, 60LL-30TL, 40LL-20TL, or 20LL-10TL.

An auxiliary LL frame consists primarily of ten 200 point crossbar switches split into the right and left halves. The verticals of the right half are multiplied to the junctor switch verticals of the even numbered line link frame while the horizontals serving these verticals become an extension of the line links of the odd LL frames. A similar transposed appearance of even frame links and odd frame junctors exist on the left half. In effect, linkage is provided from the line switches of one line link frame to the junctors of its mate.

E4-3.1 PAIRED LL FRAME AUXILIARY LL FRAME IDENTIFICATION (SFD-E408)

In a particular office, the marker recognizes a paired line link frame by the presence of solid ground on the LFK lead when the associated line link connector is operated. This ground operates the marginal PRL and LFKA relays. The LFKA in turn operates the LFK relay. A nonpaired LL

frame will have resistance ground on its LFK lead, in which case only the LFKA relay operates. Relay LFKA operated operates the LFK relay and marker operation continues.

Relay PRL operated operates PRLl relay and also operates the PRLlA relay, if provided. These relays have no effect until a channel test is made. With lOTLF relay operated, and no channels available, the operate path for the FMP relay is diverted by the PRLl relay to the STP relay. Relay STP operated, with the sequential release of GC relay and operation of STP3 relay, initiates the junctor step. Subsequently, STPl relay releases and relay STP2 operates. Relay JG0 releases and JG1 relay operates.

E4-3.2 PAIRED LL FRAME MATE SEIZURE (SFD-E408)

Relay STP3 operated (with PRLl relay operated and MFK relay normal) operates the STPA relay. Relay STPA operated locks around the contact of MFK relay, and places resistance battery on the MPP lead toward the LLC. This MPP lead connects to the MPP relay in the line link preference control circuit of the mate LL frame.

Relay MPP operated has two functions:

- (1) It closes its contact in the work preference control circuit in order to seize the auxiliary LL frame when preference is gained.
- (2) It closes solid ground toward the LLC for the LL frame associated with that preference control circuit. If this particular LL frame should have its connector closed to some other marker, solid ground on the MFK lead will operate the MFK and MFL relays in that marker, opening the operate path for the STPA relay and preventing that marker from attempting mate operation.

When preference is gained in the mate LL frame preference control circuit, the auxiliary LL frame associated with this pair of LL frames is seized. Relays operate in this frame to cut through the select magnet leads from the LL frame to the select magnets of the auxiliary frame junctor switches. The choice of select magnets will be controlled by the horizontal group relays in the LL frame, and will correspond to those select magnets which are chosen on the LL frame junctor switch.

Seizure of the auxiliary LL frame will transmit resistance ground on the MFK lead through the connector to the marker. Relay MFK alone operates and with STPA relay operated, completes the operate path for the TK relay.

During this time the STP2 and JG1 relays, in combination with the PRL and PRLl relays operated, have selected the opposite half of the trunk switch, and reoperated those relays, such as the PNR (pattern normal)

relay, in the junctor step and control circuits in preparation for channel test. With the operation of the TK relay, channel test is again made.

E4-3.3 PAIRED LL FRAME AUXILIARY LL CONTROL (SFD-E409)

When the MPP relay operates, it places ground on the LV lead to the auxiliary LL frame, through the operated HGB- relays of the LL frame. This ground will operate a LV- relay and a EV or OD- relay in the auxiliary LL frame. The numerical designation of the LV- relay operated will be the same as the HG- relay operated in the LL.

The operation of the LV- relay and the EV or ODD relay will parallel the select magnets on the auxiliary LL frame with the select magnets on the original LL frame. The operation of the EV or ODD relay will close a resistance ground to the marker over the MFK lead as an indication of mate frame lockout and select magnet cut-through.

E4-4 PAIRED LINE LINK FRAME - MARKER GLARE CONDITION (SFD-E408)

There is a possibility that two markers could have simultaneous calls to mated LL frames. As described previously, the marker expects a resistance ground on the MFK lead as an indication that the MPP relay has the work preference in the preference control circuit. If there is another marker in the mate LL frame also attempting a mate frame lockout, both markers would receive direct rather than resistance ground on the MFK lead. Both markers would recognize direct ground on the MFK lead as a glare condition and set the trunk to overflow.

E4-5 PAIRED LL FRAME AUXILIARY LL - MAKE-BUSY (SFD-E408)

The auxiliary LL frame is made busy by inserting make-busy plugs into both the MBO and MBE jacks. A make-busy plug in either the MBO or MBE jack will indicate to the marker, when it is attached to the LLC, that the LL is nonpaired rather than paired.

E4-6 CLASS-OF-SERVICE IDENTIFICATION

Originally, No. 5 crossbar was arranged for a maximum of 30 classes of service, wherein the CM received class of service from the ground extended through the LL on 1/30 leads. Later, two more leads (CGA and

CGB) were added to increase the number of classes to 60. In this case one out of the original 30, and one of the added two leads were grounded to provide two groups of 30. Still later the present standard arrangement was substituted. This arrangement grounds one of the first 10 leads CS0-9 as class tens and one of the second 10 leads CS10-19 as class units, thus using 20 leads to provide 100 classes of service. The third group of 10 leads CS20-29 and the CGA and CGB leads are used to provide 20 rate treatment classes.

In a very few offices the original 30 class-of-service arrangement was modified to provide 20 classes of service and 20 rate treatment classes (using the first 20 leads CS0-19 on a 1/20 basis for class of service and using the CS20-29 and CGA, CGB leads to provide two groups of 10 rate treatment classes).

The 20, 30, and 60 class-of-service arrangements are basically the same and are shown on SFD-E410. The tens and units class of service and rate treatment arrangement for a maximum of 100 classes of service is shown on SFD-E411.

E4-6.1 LINE LINK FRAME CROSS-CONNECTIONS

The right side of SFD-E410, E411 shows the cross-connections required for various classes of service and rate treatment arrangements.

E4-6.1.1 30 Classes-of-Service - Identification by Vertical File

When the FTK1 relay of the CM operates as a check of vertical file identification (SFD-E315), it closes the V-lead to ground a V- terminal in the LL (SFD-E410). This is cross-connected to a CS0-29 terminal in the LL frame. The CS0-29 leads are extended through LJC to the CM CS0-29 terminals, and to the MTFC to produce the trouble recorder punches CS0-29. The CS0-29 terminals in the CM are also cross-connected to the following terminals: CN (coin), MR (message register), or AOC (all other classes). See SFD-E410 Note 1 for trouble card perforation on 1/x or 2/x basis.

E4-6.1.2 60 Classes-of-Service - Identification by Vertical File

The previous description applies also for 60 classes of service except there is an additional cross-connection from the VC- terminal of the LL to either the CA or CB terminal instead of to the ground terminal. The ground to operate the VGB0-11 (SFD-E410) originates through the normal MT11 relay contact and is extended to the LL via the CGA and CGB leads.

E4-6.1.3 20 Classes-of-Service Rate Treatment-Identification by Vertical File

The description for 30 classes-of-service (SCD-E4-6.1.1) applies for rate treatment except that only leads CS0-19 are used for the 20 classes.

Leads CS20-29 are used for rate treatment as indicated on SFD-E410. Cross-connections in the LL provide this information. The VR0-4 cross-connection terminals are cross-connected to class-of-service terminals 20-29 and terminals VRG0-4 are cross-connected to class-of-service terminals CA and CB to give 20 possible rate treatments. The CS 20-29 leads give the units digit of the rate treatment number and the CA or CB leads give the tens digit.

E4-6.1.4 100 Classes-of-Service - Identification by Vertical File

The 100 classes-of-service arrangement is the standard and is now used even though equipment is not necessarily provided for the maximum of 100 classes.

When the FTK1 relay of the CM operates as a check of vertical file identification (SFD-E315) it closes the V0-4 lead to ground several terminals in parallel through diodes to prevent backup of ground from one terminal to another. Since class indications from the LL is on a tens and unit basis, two cross-connections are required. VT0-4 is cross-connected to CS0-9 to cause one of the relays CST0-9 to operate for class-of-service tens. VU0-4 is cross-connected to CS10-19 to cause one of the relays CSU0-9 to operate for class-of-service units.

Where rate treatment is provided, VR0-4, is cross-connected to CS 20-29 for rate units indication. The VRG0-4 is cross-connected to CA or CB for rate tens indication.

E4-6.1.5 Identification of Class-of-Service by Hold Magnet (SFD-E410, E411)

Where identification of class-of-service is provided on an individual hold magnet basis rather than on a vertical file basis, the V0-4 or VU0-4 terminal is cross-connected to the VFA, VFB or VFC terminal to operate a VFA, B or C relay. The HMC- terminal is cross-connected to a CS0-29 terminal for 30 or 60 classes, to CS0-19 for 20 classes or to CS10-19 for 100 classes. This method is used with line link pad control on line link pulsing only.

If rate treatment is provided, it may also be identified on a hold magnet basis where class-of-service is so identified by cross-connecting from HMR0-9 to CS20-29.

E4-7 CONTROL OF CLASS-OF-SERVICE BY MASTER TEST CONTROL (SFD-E410, E411)

Because offices may be equipped with any of several class-of-service and rate treatment arrangements, there are necessarily a number of optional arrangements provided in the MTC for controlling class-of-service and

rate treatment. On an OR class-of-test when the keys or switches for selecting class-of-service and rate treatment are in normal or off position, the CM functions as on a service call to obtain the class-of-service (and rate treatment is provided) from cross-connections in the LL. The ground from the marker which is normally steered through LL cross-connections is, instead, steered through class-of-service and rate treatment keys of the MTC. Use of these keys to control class-of-service is intended for use on OR class-of-test, so that any desired class-of-service may be set in the DTM for subsequent transfer to the OR.

E4-7.1 30 OR 60 CLASSES-OF-SERVICE (SFD-E410)

On test calls, the MT27 relay in the CM is operated. This opens the normal path through which the CM supplies ground over a V-lead to the LL to determine class-of-service from cross-connections in the LL.

When the CST- keys or CST switch are in the off position, the KCS0, 1 and 2 relays are normal and bridge the M27 relay break-contact in the CM to permit normal determination of class-of-service from cross-connections in the LL.

When the CST- key or the CST switch is operated to 0, 1 or 2 on an OR class-of-test, the KCS0, 1 or 2 relay, respectively, is operated. When the FTK1 relay operates, ground via the CSG2 lead is steered through an operated KCS- relay contact and through an operated CSU- key or the CSU switch in position 0-9 and again through contacts of an operated KCS-relay to one of the CS0-29 leads corresponding to the keys or key and switch operated.

E4-7.2 60 CLASSES-OF-SERVICE (SFD-E410)

When there are 60 classes-of-service, in addition to the control described above, the MT11 relay is operated on marker test calls and connects the CGA and CGB leads in control of the KCSA relay.

E4-7.3 20 CLASSES-OF-SERVICE WITH RATE TREATMENT (SFD-E410)

This is a feature provided in very few offices. Class-of-service functions as previously described for classes 0-19. The CST2 key or the 2 position of the CST switch is disabled. Instead, keys CRU0-9 or the CRU switch are provided.

To control class-of-service and rate treatment settings in the marker, the CST- keys or CST switch, the CSU- keys or switch, the CRU- keys or CRU switch, and the CSGA/B keys must be set as required.

E4-7.4 100 CLASSES-OF-SERVICE (SFD-E411)

On test calls, the MT27 relay in the CM is operated. This opens the normal path over which the CM supplies ground over a V- lead to the LL to determine class-of-service from cross-connections in the LL. When the CST- keys or CST switch, the CSU- keys or CSU switch, and the CRU- keys or CRU switch are in the normal or off position, the KCS0 1 and 2 relays are normal. This bridges the MT27 contacts in the CM to permit normal determination of class-of-service and rate treatment from cross-connections in the LL.

To control the setting of class-of-service and rate treatment in the CM, the CST- keys or CST switch, CSU- keys or CSU switch and, if provided, the CRU- keys or CRU switch should be set as desired. This operates the KCS0, 1 and 2 relays to extend the CSG2 lead ground to one out of ten of the CS0-9, CS10-19 to operate a CST- and CSU- relay, respectively, in the CM. When rate treatment is provided, the CSGA or CSGB key should also be operated.

SECTION E, PART 5

CHANNEL SELECTION AND HOLD MAGNET OPERATION
AND RINGING SELECTION SWITCH CONTROL

Index

		<u>PAGE</u>
E5	NETWORK CONNECTIONS	E5-3
E5-1	CHANNEL ARRANGEMENTS	E5-3
E5-1.1	JUNCTOR SEQUENCE CONTROL	E5-3
E5-1.1.1	Control of Junctor Sequence by Master Test Control	E5-5
E5-1.2	OFFICE SIZE TRUNK LINK FRAMES	E5-6
E5-1.3	SINGLE PAIRED OR TRIPLE TRUNK LINK FRAME OPERATION	E5-6
E5-1.4	OFFICE SIZE LINE LINK FRAMES	E5-6
E5-1.5	PATTERN UNITS	E5-6
E5-1.6	NUMBER OF JUNCTOR SUBGROUPS	E5-7
E5-1.7	QUAD RELAYS	E5-7
E5-1.8	PATTERN TENS	E5-7
E5-1.9	TEST CHANNEL RELAYS - TEST CHANNEL CHECK	E5-8
E5-1.10	JUNCTOR SUBGROUP SELECTION	E5-8
E5-1.11	JUNCTOR SUBGROUP CONNECTOR RELAYS	E5-9
E5-1.12	JUNCTOR CONNECT RELAYS - JUNCTOR CONNECT CHECK	E5-9
E5-1.13	CONNECTION TO LINKS OF HORIZONTAL GROUP ON LINE LINK FRAME	E5-10
E5-1.14	CONNECTION TO LINKS OF TRUNK SWITCH ON TRUNK LINK FRAME	E5-11
E5-1.15	CHANNEL TEST	E5-11
E5-1.16	TEST CHECK	E5-11
E5-1.17	SELECTION OF A CHANNEL	E5-12
E5-1.18	NO IDLE CHANNEL, RECYCLE, FAILURE TO MATCH, ROUTE ADVANCE	E5-12
E5-1.19	ROUTE ADVANCE CONTROL BY MASTER TEST CONTROL	E5-13
E5-1.20	CONTROL OF CHANNEL SELECTION BY MASTER TEST CONTROL	E5-13
E5-1.20.1	Particular Channel Selection	E5-14
E5-1.20.2	Combined Particular Junctor Step and Channel Selection	E5-14
E5-2	SELECT MAGNET OPERATION	E5-14
E5-2.1	LINE LINK FRAME SELECT MAGNET OPERATION	E5-14
E5-2.2	TRUNK LINK FRAME JUNCTOR SELECT MAGNET OPERATION	E5-15
E5-2.3	TRUNK LINK FRAME TRUNK SELECT MAGNET OPERATION	E5-15
E5-3	HOLD MAGNET OPERATION - NETWORK AND LINE TEST	E5-16
E5-3.1	DETERMINATION OF LIGHT OR HEAVY TRAFFIC BY CM-HTR/LTR	E5-16
E5-3.2	HOLD MAGNET TIMING - HTR/LTR	E5-16

E5-3.3	CHECK OF CHANNEL - HTR/LTR	E5-17
E5-3.4	CROSS CHECK OF TRUNK SLEEVE - HTR/LTR	E5-17
E5-3.5	HOLD MAGNET START - HTR/LTR	E5-18
E5-3.6	HOLD MAGNET OPERATION - HTR/LTR	E5-18
E5-3.7	DUAL VOLTAGE OPERATION - HTR/LTR	E5-18
E5-3.8	OPERATION OF LINE HOLD MAGNETS - HTR	E5-18
E5-3.9	OPERATION OF JUNCTOR AND TRUNK HOLD MAGNETS - HTR/LTR	E5-19
E5-3.10	CROSSPOINT CHECK - HTR/LTR	E5-19
E5-3.10.1	Heavy Traffic	E5-19
E5-3.10.2	Light Traffic	E5-20
E5-3.11	FALSE CROSS AND GROUND TEST - LTR	E5-20
E5-3.12	DELAYED OPERATION OF LINE HOLD MAGNET - LTR	E5-20
E5-3.13	CONTINUITY TEST, GENERAL - LTR	E5-21
E5-3.13.1	Continuity Test Reversal Control - LTR	E5-22
E5-3.13.2	Continuity Test Description - LTR	E5-22
E5-3.13.3	Continuity Failure Trouble Record - LTR	E5-22
E5-3.13.4	Cancel Continuity - LTR	E5-22
E5-3.14	DOUBLE CONNECTION TEST - HTR/LTR	E5-23
E5-3.14.1	Heavy Traffic	E5-23
E5-3.14.2	Light Traffic	E5-23
E5-3.15	HOLD MAGNET SIMULATION AND CONTROL BY MTC	E5-23
E5-3.15.1	NTC Key Normal	E5-23
E5-3.15.2	NTC Key Operated	E5-24
E5-3.15.3	Dual Voltage Test	E5-25
E5-3.16	TEST OF FALSE CROSS AND GROUND DETECTION FEATURE	E5-25
E5-3.16.1	FCG Key Normal	E5-25
E5-3.16.2	FCG Key Operated	E5-25
E5-3.17	TEST OF CONTINUITY TEST FEATURES	E5-25
E5-3.17.1	CON and RV Keys Normal, TC Key Operated or Normal	E5-25
E5-3.17.2	RV Key Operated, CON Key Normal, TC Key Operated or Normal	E5-26
E5-3.17.3	CON Key Operated, RV and TC Keys Normal	E5-26
E5-4	RINGING SELECTION SWITCH CONTROL	E5-26
E5-4.1	SETTING THE RINGING SELECTION SWITCH	E5-26
E5-4.2	RINGING SWITCH HOLD MAGNET OPERATION	E5-27
E5-4.3	RINGING SWITCH SELECT MAGNET SIMULATION BY MTC	E5-27
E5-4.4	RINGING SWITCH HOLD MAGNET SIMULATION BY MTC	E5-27
E5-5	ADVANCE TO CALL BACK	E5-27

E5 NETWORK CONNECTIONS

The channel test leads are closed through to select an idle channel between the called customer and one end of the ITR trunks, and the select and hold magnets are operated to connect the linkage through the LL and TL frames.

The established channel is checked for a satisfactory connection, and that the ringing switch operation is completed. The marker LK1,2 relays operated indicate that the FLG operation is completed and that advance must be made to set up the CB (call back) linkage.

E5-1 CHANNEL ARRANGEMENTS

A channel is made up of a line link, a junctor and a trunk link, which are tested, selected and treated as a unit when establishing a connection between a line and a trunk or between two trunks.

The line links consist of the line switch banjo wiring, the line junctor switch banjo wiring, and the wiring between these switches.

The trunk links consist of the trunk switch vertical unit, the trunk junctor switch vertical unit, and the wiring between the two switches.

The juncctors consist of the line junctor switch vertical unit, the trunk junctor switch banjo wiring, and the wiring between the line junctor and trunk junctor switches.

The marker in selecting a channel, tests a maximum of ten channels at a time. The CHT- (channel test) relay tests a line link, a junctor, and a trunk link with numbers corresponding to the CHT- relay numbers. These tests are made simultaneously. Ground on any of the test leads operates a CHT- relay to indicate a busy channel. The channel number corresponds to the junctor switch number 0-9 on both the LL and the TL, the horizontal level 0-9 on the LL line switch, and the vertical number of the trunk switch on the TL.

E5-1.1 JUNCTOR SEQUENCE CONTROL (SFD-E506, E507)

The number of juncctors in a junctor group may vary from a maximum of fifty juncctors to a minimum of ten juncctors. Since the marker is equipped to simultaneously test a maximum of ten channels and, therefore, to test a maximum of ten juncctors, each junctor group is subdivided into junctor subgroups consisting of ten or less juncctors. The marker selects those juncctors within one junctor subgroup when testing for an idle channel. The selection of the subgroup of ten or less juncctors is, in general, determined by the following factors:

- (a) The number of TLs in the marker group as indicated by the 2-10 TLF relays.
- (b) The LL number.
- (c) The junctor sequence position JSQ 0-5 which is used to equalize and rotate the traffic among the subgroups.
- (d) The junctor step STP1/2 position.

The selected subgroup of junctors is assigned to the ten channels so that the numerical designation of the junctor switch on both the LL and the TL to which the junctor connects is also the numerical designation of the channel of which the junctor is a part.

The junctor sequence walking circuit is shown on SFD-E507. A sequence chart showing the advance of the walking circuit on successive calls is shown on SFD-E506.

In the beginning of the call when the CKG4 relay operates, CKG4 in turn operates the LLC1,2 (line link control) relays. If the sequence circuit is in an even position (JSQ0,2 or 4 and JLO operated), the LLC2 relay operates the JSQ relay which locks. When the LLC2 relay releases at the end of the call, the next higher numbered odd JSQ- relay operates, and, in turn, operates the JLE relay. The JLE relay releases the JSQ-, JLO and JSQ relays. Similar operation occurs when stepping from an odd to an even JSQ relay.

Six steps of control for preference circuits are provided by the JSQ 0-5 relays. This number is doubled by the operation of the SQ0 and SQ1 relays. If the SQ1 relay is normal when the JSQ0 relay operates, the SQ0 relay operates. If the SQ1 relay is operated when the JSQ0 relay operates, the SQ0 relay releases. Similarly, the SQ1 relay is operated or released depending on the condition of the SQ0 relay when the JSQ2 relay operates. The SQ0 relay is operated for one complete cycle of the walking circuit, then released for one complete cycle. The same applies to the SQ1 relay. However, since the SQ0 is operated and released by JSQ0, and SQ1 is operated and released by JSQ2, there are steps during which SQ0 and SQ1 may both be operated or both released.

The SQA relay monitors operations of the junctor sequence walking circuit. If the SQA relay operates as a result of trouble in the walking circuit, it operates the MXT (master cross test) relay which causes a trouble record to be produced showing an SQA trouble punch.

The following conditions cause operation of the SQA relay which is a slow operate relay to prevent false operation due to momentary closures as relays change conditions. The SQA relay operates the MXT relay which operates the TR1 relay to cause a trouble record to be taken showing an MXT and an SQA punch. The MXT is not shown on a single-sided card.

Trouble conditions detected between calls (LLC2-normal) occur when:

- (a) Both JLE and JLO are normal
- (b) Both JLO and JSO are operated
- (c) Both JLE and JSE are operated

Trouble conditions detected during calls (LLC2 operated) occur when:

- (a) JLO is operated and JSO is normal
- (b) JLE is operated and JSE is normal
- (c) SQ0 and SQ1 are both operated or both are normal when JSQ1 is operated
- (d) SQ0 is operated and SQ1 is normal or SQ0 is normal and SQ1 is operated when JSQ1 is operated

When the fuse which supplies battery to the walking circuit is inserted, the SQA relay will operate because the JLE and JLO relays are both normal. When the SQA relay operates, it operates the JSQ0 relay which operates the JLO relay which should release the SQA relay if there is no trouble in the walking circuit. This will cause a trouble record to be taken which will show an MXT punch, but no SQA punch unless the SQA remains operated because of trouble. The MXT is not shown on a single-sided card.

E5-1.1.1 Control of Junctor Sequence by Master Test Control (SFD-E507)

With one of the JSQ0-5 keys or switches operated and the KCH relay operated, the MT8 relay of the marker is operated after the master test frame connector has operated the MT relay of the marker. The MT8 relay of the marker operated, releases the operated JSQ0-5 relay of the marker by opening its locking circuit. The released JSQ- relay releases the JLE or JLO relay of the marker and the released JLE or JLO in turn operates the KJSQ relay. The KJSQ relay closes ground from a back contact of the MT8K relay through the operated JSQ0-5 key or switch to operate the corresponding JSQ0-5 relay of the marker. This operates the JLE or JLO relay of the marker which removes ground from the KJSQ lead to release the MT8 relay of the marker whose operate path has been transferred to the KJSQ lead by the KJSQ relay of the test circuit when it operated and locked to ground on the KCH relay operated. The MT8 relay normal, closes the MT8K lead to operate the MT8K relay of the test circuit. The MT8K relay operated, locks to the KCH relay, removes ground from the JSQ0-5 lead, and extends ground to operate the MC relay. With all JSQ0-5 keys normal or the switch in the off position, or with the KCH relay normal the junctor sequence relays of the marker function in a normal manner.

If no JSQ0-5 key or switch is operated, the MTF lead to the marker is open and the MT8K lead is closed to the MC relay through normal contacts of the JSQ0-5 key or switch. The KCH relay normal bridges the MT8K lead around contacts of the JSQ0-5 keys or switches.

E5-1.2 OFFICE SIZE TRUNK LINK FRAMES (SFD-E507)

A cross-connection in each CM from the SZD terminal to one of the terminals SZ2-10 indicates the size of the office in terms of the number of single trunk link frames in a nonpaired office, number of pairs of trunk link frames in a paired office, or number of trunk link frame triples in a triple office.

During transition from one size office to another, some trunk link frames may have a junctor pattern for one size office while others have a different size office junctor pattern. In this case, the SZA, SZB, and SZC terminals are cross-connected to appropriate SZ2-10 terminals in each marker, and the G terminal of each trunk link frame is cross-connected to SZA, SZB, or SZC terminals as required. These cross-connections are changed in individual trunk link frames as the transition progresses. Upon completion of the transition, the SZD terminal of each CM is cross-connected to the SZ2-10 terminal corresponding to the new office size.

E5-1.3 SINGLE PAIRED OR TRIPLE TRUNK LINK FRAME OPERATION (SFD-E510)

A cross-connection in each CM from the SPF terminal to the SF, PR, or TTF terminal indicates to the CM whether the office is arranged for single, paired, or triple trunk link frame operation. During transitions, however, from single to paired, or paired to triple-trunk link frame operation, the marker cross-connections are removed and cross-connections are made in each TLC. A frame which has not been modified might be cross-connected as a STF (single trunk link frame) while another frame which has been modified might be cross-connected as a PR (paired trunk link frame).

E5-1.4 OFFICE SIZE LINE LINK FRAMES (SFD-E510)

The marker determines office size in terms of number of line link frames from a combination of the office size in terms of trunk link frames (SCD-E5-1.2) and the indication of single, paired, or triple trunk link frame operation (SCD-E5-1.3). The 20F relay operates for 1-20 line link frames, the 40F relay for 21-40 line link frames and the 60F relay for 41-60 line link frames.

E5-1.5 PATTERN UNITS (SFD-E504)

In the following size offices all junctor subgroups have 10 junctors.

2TLF Single, paired or triple.

2-3TLF Single, paired or triple.

5TLF Single, paired or triple.

10TLF Single, paired or triple.

All other sizes have some junctor subgroups with less than 10 junctors.

To determine which junctors are equipped, one P0-9 (pattern unit) relay is operated in the CM. The SFD-E504 shows how a particular pattern unit relay is operated for TLO in an office having single TL operation. It also shows particular pattern unit relay operation for either TL of TL pair 0 in an office having paired TL operation. Also, shown is a particular pattern unit relay operation for any TL of TL triple 0 in an office having triple TL operation. The choice of a pattern unit relay is determined by the line link frame number (FUT0-9 relay and FTB0-3 relay operated) and the line link office size relay 20F, 40F, or 60F operated.

E5-1.6 NUMBER OF JUNCTOR SUBGROUPS (SFD-E508, E509)

This applies only to 6 TLF and 7 TLF size offices. Both of these office sizes have some junctor groups with two, and other junctor groups with three junctor subgroups. With either relay 6 TLF or 7 TLF operated, relays P0, 2, 3 and 4 operate the 3G (3 junctor subgroup) relay while relays P4-9 operate the 2G (2 junctor subgroup) relay.

E5-1.7 QUAD RELAYS (SFD-E510)

The 7Q (seven quad) relay is used only in paired or triple trunk link frame offices of the 7 TLF size. The RQ (regular quad) relay is used only in paired or triple trunk link frame offices of 6TLF, 8TLF or 9TLF sizes. The term "quad" no longer has a valid meaning since triple trunk link frame operation came into use. Essentially, these relays provide a convenient and more economical method of steering the JC- leads (SFD-E521) than by using contacts of TLF for a particular size offices.

E5-1.8 PATTERN TENS (SFD-E505)

The PNR relay is always operated by the following office sizes which have no subgroups of less than 10 junctors.

2TLF Single, paired or triple

2-3TLF Single, paired or triple

5TLF Single, paired or triple

10TLF Single, paired or triple

The PNR relay is also operated for certain other office sizes when the marker is directed by the operated or released condition of the STP1, STP2, and JSQ relays to junctor subgroups having 10 junctors. When the marker is directed to subgroups having less than 10 junctors, one of the pattern tens relays PA, PB, PC, or PE is operated.

E5-1.9 TEST CHANNEL RELAYS - TEST CHANNEL CHECK (SFD-E522, E525)

The marker determines which channels are equipped in a subgroup by operating one, two, etc, or all TCHO-9 relays (SFD-E522). The PNR relay operates all ten TCH- relays. The combination of one pattern tens and one pattern units relay operates only those TCH- relays corresponding to equipped junctors.

The operation of any TCH relay operates the TCHK relay (SFD-E525) which locks to the operated CHA relay.

E5-1.10 JUNCTOR SUBGROUP SELECTION (SFD-E508, E509)

To simplify the path for operation of the JG relays, SFD-E508 shows operate paths for offices with 2, 2-3, 5, or 10 TLF-size while SFD-E509 shows operate paths for all other sizes 3, 4, 6, 7, 8, and 9. Note on SFD-E508 that only the JG0 relay can be operated for the 10TLF size since there is never more than one junctor subgroup. For the 5TLF size either JG0 or JG1 relay may be operated. For the 2-3TLF size, JG0 or JG3 relays may be operated. For the 2TLF size, JG0-JG4 relays may be operated. Since no pattern units relay is required for these office sizes, the 1-out-of-10 check of the P- relay is bypassed.

Office sizes 3, 4, 6, 7, 8, and 9TLF each have one or more junctor subgroups with less than 10 junctors and, therefore, must operate a pattern unit relay. Ground for operating the JG-relays is provided through a 1-out-of-10 check of pattern unit relays, and if the office has triple trunk link frames, a similar check through pattern auxiliary relays.

For any size office, the STP1 relay (SFD-E525) is always operated at the beginning of a call. If no idle channel is available in the junctor subgroup selected through the STP1 relay, the STP1 relay will be released and the STP2 relay operated to operate a different junctor subgroup, JG- relay. This applies to all sizes except 10TLF which has only one junctor subgroup.

The walking circuit is stepped to a new position at the end of each call for office sizes having more than one junctor subgroup. Different subgroups are given preference according to which JSQ0-5 and JLE or JL0 relays are operated.

E5-1.11 JUNCTOR SUBGROUP CONNECTOR RELAYS (SFD-E525, E510)

The GC or GCA relay in some cases with triple trunk link frame operation (SFD-E525) operates early in the call from the LLC1 relay. The operated GC or GCA relay steers battery through contacts of an operated JG0-4 relay to operate a junctor subgroup connect relay G0-4 in the trunk link connector (SFD-E510). A 1-out-of-5 check through the JG0-4 relay ensures that only one relay is operated. To detect crossed G-leads to the TLC, normal JG- relays ground associated leads. If the lead associated with the operated JG- relay is crossed to any other lead, the direct ground causes sufficient current to flow through the XJG relay to operate it. The XJG relay is biased to not operate on the current required to operate the G- relay in the TLC. If the XJG relay operates, it in turn operates the XAJG relay which locks and causes a trouble record showing XJG punch to be taken.

E5-1.12 JUNCTOR CONNECT RELAYS - JUNCTOR CONNECT CHECK (SFD-E521, E527)

Junctor connect relays JC0-9 are associated with regular trunk junctor switches. Relays JC10-19 are associated with extension trunk junctor switches. Relays JC20-29 are associated with supplementary trunk junctor switches. The JC0-9 leads are partially closed by the previously operated G0-4 relays in the TLC.

The path for operating the JC- relays is shown on SFD-E521. Battery is supplied through the primary winding of the XJC relay so that the XJC relay is connected to ground through more than one JC relay winding. The XJC relay is biased through its secondary winding. If more than two JC leads are crossed or grounded, the current through the primary winding is sufficient to overcome the bias of the secondary and operate the XJC relay. When the XJC relay operates, it operates the XAJC relay which causes a trouble record showing a XJC punch.

When the G0 relay in the TLC is operated, JC0-9 leads from the marker are closed through directly to the JC0-9 leads, respectively, to the TL. However, relays G1-G4 close the JC0-9 leads from the marker to cross-connection terminals G10-19, G20-29, G30-39, and G40-49. The cross-connections required are different for each office size and vary between TLC associated with different TL in the same office.

To steer the activated JC lead to the proper JC0-9, JC10-19, or JC20-29 relays, the marker operates an RF, EF, or SEF relay (regular, extension, or supplementary extension frame, SFD-E520). Battery to operate one of these relays is fed through the winding of the XF relay which is biased to operate if the RF, EF, or SEF leads are grounded or crossed so that the XF relay supplies current to more than one relay. If the XF relay operates, it operates the XAF relay which causes a trouble record showing an XF punch.

The JC0 relay (SFD-E529) connects to the sleeve leads of the level 0 junctors on the left and the level 0 junctors on the right of each of the junctor switches 0-9. The JC0 relay also connects to ten different level 0 select magnets, one on each junctor switch 0-9. Similarly, each of the JC1-9 relays connect to sleeve leads and select magnets associated with levels 1-9, respectively, on each of the junctor switches 0-9. To associate with the junctors located on the right or left half of the switches, a marker operates R, ER, and SER relays or L, EL, and SEL relays (SFD-E520). The ER and EL relays (extension right and left) are required only for paired and tripled TL operation. The SER and SEL relays (supplementary extension right and left) are required only for triple TL frame operation. The battery to operate these relays is fed through the winding of the XLR relay. The XLR relay is biased to operate when connected to more than one relay, either L or R when the STF relay is operated for single TL frame offices. It is biased to operate when connected to more than three relays (R, ER, and SER, or L, EL, and SEL) when the STF and PR relays are normal in triple trunk link frame offices. It should be noted (SFD-E510) that during transitions STF or PR may be operated or nonoperated depending on which TLC is used. A TLC which has not been changed over from single to paired operation would still operate the STF relay, while a TLC which had been modified would operate the PR relay.

When a JC relay operates, the JCK relay (SFD-E527) on the JS0 lead operates to ground through one of the select magnets on the 0 junctor switch as a check that the JC relay has operated. The JCK winding resistance, and JCK series resistance, limit current so that although the sensitive JCK relay operates, the select magnet does not operate.

When R, ER, and SER or L, EL, and SEL operate, the RK or LK (right check or left check SFD-E520) relay operates through contacts of all three relays in series as a check to the marker that they have operated.

E5-1.13 CONNECTION TO LINKS OF HORIZONTAL GROUP ON LINE LINK FRAME (SFD-E407, E524)

Operation of the HGA, HGB relays of the LL frame are shown on SFD-E407. Operation of these relays is checked by operation of the HGK relay of the CM. The operated HGB relay closes through LL0-9 leads to each of the ten links associated with that horizontal group (SFD-E524).

The selected group of ten line links is assigned to ten channels so that the numerical designation of the channel is identical with the numerical designation of the line link test lead LL0-9. The designation also agrees with the numerical designation of the junctor switch and the horizontal level of the line switch which are connected by the line link.

E5-1.14 CONNECTION TO LINKS OF TRUNK SWITCH ON TRUNK LINK FRAME (SFD-E211, E529)

The selected trunk F relay controls the operation of the FA or FB relay in the TL (SFD-E211). Operation of the FA or FB operates the proper LV2-9 (level connector) and LC0-9 (link connector) relays in the TL for marker control of the select magnet operation, channel test, and hold magnet operation (SFD-E529). The A or B appearance and the horizontal level of the trunk switch is checked by the operation of the FAK or FBK relay in the marker (SFD-E211). To check that the LC relay operated, the LCK relay in the marker operates. The operated LC relay connects to sleeve leads of the links associated with the trunk switch on which the trunks appear (SFD-E529). The operated L or R relay closes through ten sleeve leads associated with the left or right half of the trunk switch (SFD-E529).

The selected group of ten trunk links are assigned to the channels so that the numerical designations of the channel of which the trunk link is a part is identical with the numerical designation of the trunk link test lead LH0-9, and with the numerical designation of the TL junctor switch to which the trunk link connects.

E5-1.15 CHANNEL TEST (SFD-E524)

Ten channel test relays CHT0-9 are connected through diodes to ten line link sleeves, ten junctor sleeves and ten trunk link sleeves (SFD-E524). Diodes in each lead prevent a ground on one leg of a channel such as a line link feeding through to another leg of the channel such as the junctor or trunk link, while at the same time permitting a ground on the sleeve of any of the three legs to operate the associated CHT relay. The test paths for the 0 channel are shown in red on SFD-E524. The STX relay (SFD-E109) operates early in the call and provides direct battery to the CHT relay windings. Between calls the STX relay is released. If any of the channel test leads are falsely grounded to either the line or trunk link connectors, the XCH relay will operate between calls. The XCH relay operates the XACH relay which locks and causes a trouble record showing an XCH punch.

E5-1.16 TEST CHECK (SFD-E525)

The preceding paragraphs have described a number of operations which proceed at the same time in preparation for selection of a channel. Upon successful completion of each operation, a check relay operates. These check relays are summarized below.

TCHK - Checks that at least one TCH relay has operated.

JCK - Checks that a JC relay in the TL has operated.

RK/LK - Checks that a R or L relay in the TL has operated.

FAK/FBK - Checks that a FA/FB relay and an LV relay in the TL has operated.

LCK - Checks that a LC relay in the TL has operated.

HGK - Checks that a HGA and HGB relay in the LL has operated.

SCCK - Checks that originating class of service relays have operated.

When all of the above relays have operated, ground from the operated JCK relay operates the TK (test check) relay.

E5-1.17 SELECTION OF A CHANNEL (SFD-E525)

The LLC1, CHT, and SLRK relays will have operated early in the call. With the LLC1 relay operated, ground is closed to operate a CH0-9 relay. There is a double chain path composed of CHT0-9 relays and TCH0-9 relays to determine which CH0-9 relay, if any, is to be operated. Some or all of the TCH- relays (SFD-E522) will be operated as an indication of which channels are provided in the subgroup being tested. Any channel which is busy (SFD-E524) will have an operated CHT relay. If the TCH0 relay is operated and the CHT0 relay is normal, the CH0 relay operates and locks. If, however, either TCH0 relay is normal or CHT0 relay is operated, ground is passed to operate the next relay in the chain which has an operated TCH relay and a normal CHT- relay. When one CH- relay has operated and all others are normal, the CHA relay operates as an indication that a channel has been selected.

E5-1.18 NO IDLE CHANNEL, RECYCLE, FAILURE TO MATCH, ROUTE ADVANCE (SFD-E525, E512, E513, E514, E515, E517, E519)

If there is no idle channel, that is, no CH- relay having both an operated TCH- relay and a normal CHT- relay (SFD-E525), the FMP relay operates in a 10TLF size office. In all other size offices, the STP relay operates. Refer to the flow chart (SFD-E512) and the sequence charts (SFD-E513, E514, E515) which show the general and detailed sequence of operations under various conditions.

The marker recycles when it is unable to find a channel between a line or trunk appearance on the LL and a trunk appearance on the TL. On recycles caused by failure to match, the marker makes a second attempt to complete the call by using trunks to another TL in the same route. The marker then tests the new group of channels to complete the call.

All office sizes except 10TL nonpaired, 20TL paired, or 30TL tripled have more than one subgroup of junctors. Since the marker can test only one subgroup of junctors at a time, facilities are provided to shift junctor subgroups if the marker finds all channels busy when testing the choice subgroup.

The STP operates when all available CHT0-9 relays are operated because all channels are busy. The operated STP releases the GC, and causes the marker to select another junctor subgroup.

If testing the second subgroup of junctors also results in an all channels busy indication, the operation of the CHT- will cause the FMP relay to operate.

The FMP causes the FM (failure to match) to operate and control the operation of two sets of counting relays. One set of counters (1F, 1FA, 2F and 2FA) counts the total failures to match, the RF, RFA counts the matching failures within a route.

Failures to match causes the following marker action:

1st failure causes recycle or allotter advance.

2nd failure within route causes route advance.

3rd failure causes route advance; register returns busy-tone.

Route advance occurs when the marker cannot find an idle channel. The R- (route) relays are divided into blocks with each block being wired to one of the GS- ground supply relays. Each GS- relay supplies ground to the contacts of the R- relays in the block.

The marker provides six ground supplies. Depending on the office involved, the route relays are assigned to the ground supplies to provide the required direct and alternative routing.

Ground supplies one through four are used for direct and alternate routes. Ground supply five is used for tone trunks. Ground supply six is used for common overflow trunks.

E5-1.19 ROUTE ADVANCE CONTROL BY MASTER TEST CONTROL (SFD-E516)

Route advance is controlled by an RAO-3 key (or RA switch, or RAU switch and RAT1 key) which is operated to cause the marker to route advance a number of times corresponding to the key operated or position of the switch, and to allow the marker to select a trunk link frame only after it has route advanced that number of times, but not after it has route advanced more than that number of times. The RA(1-11) lamps indicate the number of route advances.

E5-1.20 CONTROL OF CHANNEL SELECTION BY MASTER TEST CONTROL (SFD-E522, E523)

The marker can be directed to select a particular channel under control of the CH0-9 keys or switch, and to select a particular junctor step position under control of the STP1/STP2 key.

E5-1.20.1 Particular Channel Selection (SFD-E522, E523)

With the CH- keys or switch and the STP1/STP2 keys normal, there is no control of channel selection from the master test control circuit and a channel is selected at random as on a service call. With the CH- keys or switch operated, the MT7 relay in the marker operates. This opens the grounds normally used by the marker to operate TCH0-9 relays. The operated CH-key or switch provides ground on one of the TCH0-9 leads to permit the corresponding TCH0-9 relay to operate, but only if it would normally have been operated by the combination of pattern relays operated. This procedure restricts the marker so that it can operate only a channel relay corresponding to the operated CH- key or switch. The CH- relay can be operated only if the channel is idle (as indicated by the corresponding CHT- relay normal).

If a particular channel is not available in STP1, the marker makes a retest to try to find a channel in STP2 (except in 10TLF, 20TLF, and 30TLF size office) (SFD-E523). Again the marker is restricted to select only the channel corresponding to the operated CH- key or switch.

E5-1.20.2 Combined Particular Junctor Step and Channel Selection (SFD-E522)

When a STP1 or STP2 key and a CH- key or switch are operated together, the CM is restricted to selection of a particular channel within a particular junctor step. The MT7 relay of the CM remains operated in both Step 1 and Step 2. The STP relay of the MTC is operated during Step 1 with the STP1 key operated and during Step 2 with the STP2 key operated. This feeds ground through the operated CH- keys or switch to permit selection of only that channel corresponding to the operated CH- key or switch.

E5-2 SELECT MAGNET OPERATIONE5-2.1 LINE LINK FRAME SELECT MAGNET OPERATION (SFD-E526)

Upon operation of a CH- relay, battery through the LS and LSA resistance lamps is closed to the select magnets on the line link frame. This battery is steered by the operated HGA- relay to the proper link select magnets and junctor hold magnets. It should be remembered that the line junctor switches also serve as line switches. One-half of the verticals is for junctors and the other half is for lines. If the CHO and HGA0 relays are operated for a line on one of the number 0 line switches to a junctor on the 0 junctor switch, an L0 and an LJ0 select magnet are operated. The LJ0 select magnet would serve a customer on the line side of the line junctor switch. If the CH1 relay and HGA0 relays are operated for a line on one of the number 1 line switches to a junctor on the

0 junctor switch, the LJ1 select magnet for the 0 junctor switch would operate, but the LJ0 select magnet on the number 1 junctor switch would also be operated to serve a line on the line side of the number 1 junctor switch.

When paired LL frame operation is provided, the select magnet leads extend to the auxiliary LL frame. The XLS relay is connected to SM- leads through normal contacts of all but the operated CH- relay. If the SM- lead through the operated CH- relay is crossed to any of the other SM- leads, the XLS relay will operate to the applied battery and lock. The XLS relay operates the MXT relay which causes a trouble record to be taken showing an XLS punch.

E5-2.2 TRUNK LINK FRAME JUNCTOR SELECT MAGNET OPERATION (SFD-E527)

Upon operation of a CH- relay, battery is closed to junctor select magnets on the TL. The operated CH- relay closes an JS- lead to a junctor switch of the same number as the CH- relay. An operated JC- relay on the TL closes the JS- lead to a select magnet of the same number as the last digit of the JC- relay. The JC0-9 relays are associated with the regular TL. The JC10-19 relays are associated with the extension TL, and JC20-29 are associated with the supplementary extension TL.

It should be noted that the JCK relay, which operated as a check that a JC- relay has operated, is released if the CHO relay operates to apply battery to the JS0 lead. For this reason, the JCK punch will not appear on trouble cards where channel 0 is shown.

Battery to the JS- leads is fed through the XJS relay which is biased to operate if it is connected to ground through more than one select magnet. If the XJS relay operates, it operates the XAJJS relay. The XAJJS relay operates the MXT relay which causes a trouble record to be taken showing an XJS punch.

E5-2.3 TRUNK LINK FRAME TRUNK SELECT MAGNET OPERATION (SFD-E527)

When the FAK or FBK relay in the marker operates, the battery is extended to the TL on the ASM or BSM lead. This battery is directed by the operated LV- and FA- or FB- relays in the TL to operate a select magnet on the A or B trunk switch steering level and on the level of the selected trunk. Ground for the trunk level select magnets is provided by the marker on the TSX lead. This ground is present upon the release of TSE1 relay immediately following the selection of an idle trunk.

After trunk selection, when the TSE1 relay has released and the FAK or FBK relay has operated, the XTS relay is connected to the TSX lead. The XTS relay is biased to operate if it is connected to battery through more than one T2-9 select magnet. If there is a cross which closes the ASM lead to more than one of the select magnets T2-9, the XTS relay operates and in turn operates the XATS relay which operates the MXT relay to cause a trouble record showing an XTS punch.

E5-3 HOLD MAGNET OPERATION-NETWORK AND LINE TEST

The sequence of hold magnet operation differs, depending on whether the marker determines that traffic is heavy or light. Under heavy traffic conditions all hold magnets are operated at the same time with a minimum of checks and tests to reduce marker holding time. Under light traffic condition, operation of the line hold magnet is delayed to permit a test of the talking path for crosses. After the line hold magnet has operated, a continuity test of the talking path crosspoints is made.

Headings of the following paragraphs are designated HTR, LTR or HTR/LTR as an indication that the paragraph applies only to heavy traffic, only to light traffic, or to either heavy or light traffic operation.

E5-3.1 DETERMINATION OF LIGHT OR HEAVY TRAFFIC BY CM-HTR/LTR

Hold magnet operation, as well as other marker functions, differ according to whether traffic is light or heavy. The CM determines whether the traffic is light or heavy by measuring the time between seizures of the CM using the HTT timer (SFD-E135).

At the beginning of a call, the MCB- relays of the CM are operated over the MB lead from the ORMC (SFD-E106). The MCB1 relay operated extends ground on the TM lead to operate the OAT relay. If the HTR relay is already operated from the last call it remains locked to ground through normal contacts of the HTT relay (SFD-E135). At the end of the call, the OAT relay releases. If the HTR relay is not already operated, it operates and locks releasing the OAT1 relay. With the OAT and OAT1 relays normal and the HTR relay operated, the shunt around the HTT capacitor (SFD-E135) is opened allowing the HTT capacitor to charge until the HTT tube fires and operates the HTT relay, or until the CM is seized again and the OAT relay operates to stop the timing. If the time between calls is greater than 0.96 to 1.6 seconds, the HTT relay operates releasing the HTR relay so that the next call is handled on a light traffic basis. If the interval is shorter than 0.96 to 1.6 seconds, the HTR relay remains operated and the call is handled on a heavy traffic basis.

E5-3.2 HOLD MAGNET TIMING - HTR/LTR (SFD-E530)

As described in preceding paragraphs, select magnets are operated on line link and trunk link frames upon operation of a CH- relay. Operation of a CH- relay also operates the CHA relay which starts a hold magnet timing interval. This time interval is necessary to allow select magnets to operate, for select fingers to seat, and for any previously operated hold magnets connected to this channel to release before operating hold magnets for this call.

Prior to operation of the CHA relay, current flows through the primary winding of the HMT relay in a direction to operate it, while current through the secondary flows in a direction to release it. The combination of external resistance, winding resistance, and difference in number of turns is such that the current in the secondary prevents the HMT relay from operating. When the CHA relay operates, current in the secondary decreases as the HMT capacitor charges. When the effect of the current in the secondary becomes less than that of the current in the primary, the HMT relay operates. This operate time can be set at 43-50 ms by cross-connecting terminal HMT1 to HMT3 or to 63-75 ms by cross-connecting terminal HMT1 to HMT2. The longer time interval is required in offices which have some switches which are not equipped with damping cones, since the select fingers on these switches take longer to settle down. Operation of the HMT relay operates the HMT1 relay.

E5-3.3 CHECK OF CHANNEL - HTR/LTR

Early in the call, the SLRK relay operates (SFD-E531) from ground on the LLC3 relay through normal contacts of the SLA, TGCK, JGCK, GLH1, GT2, HMT1 and CHA1 relays to ensure that they are initially normal. The SLRK locks when the TK relay operates. If the SLRK relay fails to operate, operation of a CH- relay (SFD-E525) is prevented.

In the process of channel test (SCD-E5-1.15, SFD-E524) busy channels are detected by looking for ground on sleeve leads. If ground is not detected on any of the three parts of a channel, it is presumed to be idle and one of the idle channels is selected by operation of a CH- relay (SFD-E525).

A further check of the channel is made after a CH- relay has operated. The JGCK and TGCK relays (SFD-E533) are connected to junctor and trunk hold magnet leads, respectively. These are high resistance sensitive relays which operate to battery on hold magnet windings without operating the hold magnets. This provides a positive check that the hold magnets associated with the channel are idle (ungrounded). A further check of the sleeve of the line link selected is made by the LLT relay. If the line link is idle the LLT relay will not operate. (SFD-E524).

E5-3.4 CROSS CHECK OF TRUNK SLEEVE - HTR/LTR

Prior to operation of the HMS1 relay, the XSL relay is connected to the AST or BST lead (SFD-E533) to detect any cross to ground. If the XSL relay operates, it locks and operates the MXT relay which causes a trouble record showing an XSL punch.

E5-3.5 HOLD MAGNET START - HTR/LTR, (SFD-E531)

With the HMT1, JGCK, TGCK, and SLRK relays operated, and other check relays released, the HMS1 relay operates to start hold magnet operation. The operation of the HMS1 relay closes circuits for operating the LL and TL hold magnets and the line hold magnet of the channel.

E5-3.6 HOLD MAGNET OPERATION - HTR/LTR (SFD-E533)

The operation of the HMS1 closes the operate circuit over the LH-, J-, and LH-(TL) leads to the LL and TL hold magnets of the selected channel. Relay HMS1 operated extends the +130 volts on the LH, JH-, and TH-capacitors to the winding of the hold magnets. The capacitors discharge through the hold magnets, causing them to operate. When the voltage across the capacitor drops to about -.5 volts the LH, JH-, and TH-diodes become forward biased and pass a steady current to hold the hold magnets operated.

The TL trunk and junctor hold magnets and the LL junctor hold magnet are always operated on a dual voltage basis.

E5-3.7 DUAL VOLTAGE OPERATION - HTR/LTR (SFD-E533)

With the standard dual voltage option, all hold magnets except the line hold magnet are operated by a high voltage surge on all calls. The line hold magnet is operated by the high voltage surge except on calls to message rate lines in offices having message registers. This is to avoid the possibility of falsely operating the message register. Lines equipped with message registers are indicated to the marker over the class-of-service leads from the LL. The class-of-service indication is received over the CS00-29 leads, which in turn are cross-connected to operate relay CNA (coinline auxiliary), AOA (all other auxiliary), MRA (message registers auxiliary), or CGS (centrex station). The operation of the CNA, AOA, or CGS relays operates the DVO relay, which in turn operates the DVA relay indicating that the marker should use dual voltage to operate the line hold magnet. The operation of the MRA indicates 48 volt operation for the line hold magnet.

With DVA or MRA operated and the HMT operated, ground is closed to operate the HMT1 relay.

E5-3.8 OPERATION OF LINE HOLD MAGNETS - HTR (SFD-E533)

Assume a heavy traffic call with a nonmessage rate line. Upon operation of the HMS1 relay, with the HTR, DVO and DVA relays operated, ground is furnished through the primary winding of the LXP relay in series with the LH capacitor. The LH capacitor (which has previously been charged

to +130 volts and acts momentarily like a 130 volt battery) is applied to the winding of the line hold magnet which is connected to -48 volt battery. The effect is as though a battery of 178 volts were connected to the relay winding. The voltage of the LH capacitor rapidly decreases to 0 and then to a fraction of a volt negative at which point the LH diode begins to conduct, so that the hold magnet is held operated to ground potential. Application of high voltage in this manner causes the hold magnet to operate in about 1/3 the time it would take if 48 rather than 178 volt operation were used.

If the DVO and DVA relays are normal, 48-volt operation is used. That is, the ground through the winding of the LXP relay is applied directly to the hold magnet without the LH capacitor in series.

With or without surge voltage operation, the LXP relay operates in series with the line hold magnet. The LXP relay operates the LXPA relay which locks (SFD-E531).

E5-3.9 OPERATION OF JUNCTOR AND TRUNK HOLD MAGNETS - HTR/LTR (SFD-E533, E531)

The HMS1 relay closes ground through the JXP relay primary winding in series with the JH capacitor charged to +130 volts over the J- lead to the winding of the line link junctor hold magnet.

The HMS1 relay also closes ground through the TXP, TXP1 resistance lamps in series with the TH1, 2 and 3 capacitors charged to +130 volts over the LH- lead to the trunk and trunk junctor hold magnets. As described for high voltage surge operation of line hold magnets, the magnets operate in about 1/3 of the time required for 48-volt operation. When the capacitor discharges, the magnets continue to be held operated through the diodes to ground through the JXP relay or the TXP, TXP1 resistance lamp. The JXP relay operates in series with the line junctor hold magnet and operates the JXPA relay which locks.

E5-3.10 CROSSPOINT CHECK - HTR/LTR (SFD-E533, E531, E524)

E5-3.10.1 Heavy Traffic

When the hold magnets have operated, the low resistance ground from the TXP, TXP1 resistance lamps operates the SL relay and releases the LXP and JXP relays which operate the LXPl and JXPl relays, respectively. The SL relay operates the SLA relay (SFD-E533). The LLT (SFD-E524) relay, which has previously operated when operation of the line junctor hold magnet grounded the line link sleeve, operates the LLTA relay. Operation of the SLA, LLTA, LXPl, and JXPl relays closes ground through the previously operated HTR relay to operate the GT1 relay, which locks.

E5-3.10.2 Light Traffic

Crosspoint check on light traffic is the same as preceding, except:

- (a) Line hold magnet operation does not occur at the same time as operation of the other hold magnets when the HTR relay is not operated.
- (b) Operation of the SLA, LLTA, and JXP1 relays closes ground through the normal HTR, LXPA, and LXPl relay contacts to operate the LTR (light traffic) relay instead of the GT1 relay.

E5-3.11 FALSE CROSS AND GROUND TEST - LTR (SFD-E535)

On light traffic calls, a test for crosses on the network tip and ring conductors is made. For this reason, the operation of the line hold magnet operation is delayed during the test so that crosses or grounds external to the network are not detected.

Ground through the secondary, and battery through the primary windings of the FCG relay are connected to the ATT or BTT and ART or BRT leads, respectively.

The FCG relay will operate if there is a false ground on the ring conductor at any point from the nonoperated LL line hold magnet crosspoints to the primary winding of the FCG relay. If there is a false battery on the tip conductor at any point, the FCG is operated by current through the secondary winding. Or, if there is a false cross between the tip and ring conductors at any point, the FCG relay is operated by current through the primary and secondary windings. The operation of the FCG relay would stop the progress of the call and produce a trouble record showing the FCG punch.

When the LTR relay operates, indicating that all crosspoints other than those for the line hold magnet have closed, a locking ground is provided for the FCG relay in case it has operated. If the FCG relay has not operated, the GLH relay operates (SFD-E530).

The GLH relay disconnects the FCG relay from the ATT or BTT and ART or BRT leads and grounds both leads to discharge any voltage remaining on them from the FCG test.

E5-3.12 DELAYED OPERATION OF LINE HOLD MAGNET - LTR (SFD-E530)

The GLH relay operates the GLH1 relay. With the GLH1 relays operated, the line hold magnet is connected either in series with the LXP primary winding to ground (if the DVO and DVA relays are normal), or in series with the charged LH capacitor to ground through the LXP primary winding,

if the DVO and DVA relays are operated. The operated LXP relay operates the LXPA relay. When the line crosspoints close, the LXP relay is forced to release by ground from the TXP and TXP1 resistance lamps. This operates the LXP1 relay.

E5-3.13 CONTINUITY TEST, GENERAL - LTR (SFD-E535)

A continuity test of the talking path through the network is made on light traffic calls. In order to check continuity of the path through the network, a path from tip to ring conductors or from either tip or ring to ground external to the network is required. Twenty-cycle (AC-DC-AUD) ringing supply is stepped up to a higher voltage by the CON2 transformer. With the GLH1 relay normal, the output of the CON2 transformer is open-circuited. There is no current flowing and, therefore, no voltage buildup across the CON2 capacitor. When GLH1 relay operates (assume RCTA relay normal), the CON2 transformer is connected through the network to the ring side of the line. Ground is connected to the tip side. On nearly all calls, the off-hook status will be connected across the tip and ring so that there will be a relatively low dc resistance in the loop. Current will flow, causing an alternating voltage to appear across the CON2 capacitor. Terminal 1 of the CON tube is connected through the CON1 resistor to the CON2 capacitor. If the voltage at terminal 1 reaches the firing voltage of the CON tube, even momentarily, the CON tube fires and continues to conduct between terminals 2 and 4 to operate the CON relay even though the voltage at terminal 1 is no longer above the firing voltage.

Occasionally the station will go on-hook just before the continuity test is applied. If this is an individual line, the path through the ringer and the series capacitor allows sufficient 20-cycle (AC-DC-AUD) frequency current to flow to raise the voltage across the CON2 capacitor to the firing voltage. The same holds true for a ring party line. In this case, current flows through the network ring lead only through the ringer and capacitor to ground and back through the earth to the central office ground. If there is only a tip party connected to the line, insufficient current may flow and the CON tube may not fire at this time (still assuming that the RCTA relay is normal at the beginning of the continuity test.) As described in more detail later, the RCTA relay operates after a short interval to reverse the continuity test. Now, current flows through the tip lead through the tip party bell and capacitor, back through the earth to the central office ground. If the RCTA relay had been initially operated and only a ring party station had been connected, the RCTA relay would have released to apply the continuity test to the ring side of the line.

On long lines, the cable capacity is sufficient to satisfy the continuity test even if there is no other path through ringers or transmitter.

E5-3.13.1 Continuity Test Reversal Control - LTR (SFD-E535)

The RCTB relay operates from ground through the HTR relay contacts normal, and prevents the RCTA relay operation for ring party stations. On continuity test of a multiparty line, the ring side of the line is tested first. If the continuity test is satisfactory, the operation of the CON1 relay locks the RCTB relay operated. If the continuity test is not satisfactory, the RCTB relay releases when the LXP1 operates, and causes the RCTA relay to operate. The operated RCTA removes the continuity test from the ring and applies it to the tip conductor.

E5-3.13.2 Continuity Test Description - LTR (SFD-E535)

Operation of the GLH1 relay, in addition to starting operation of the line hold magnet, also starts the continuity test. Stepped up 20-cycle ringing supply voltage through the CON2 transformer in series with the CON2 capacitor to ground is applied to either the tip or to the ring of the path through the network depending on whether the RCTA relay is operated or normal. Ground is applied to the other side of the path through the network. The GLH1 relay also applied +130 volts to a voltage divider supplying the winding of the CON relay.

If there is continuity through the crosspoints and continuity external to the network, the voltage across the CON2 capacitor builds up sufficiently to fire the CON tube. The CON relay operates, in turn operating the CONA relay. The CONA relay operates the CON1 relay which locks. The CON1 relay closes a locking path to prevent release of the RCTB relay (if it has not already released), operates the GT1 relay which locks, and grounds the control terminal 1 of the CON tube. The GT1 relay removes positive battery from the CON relay allowing it to release. This, combined with the grounding of control terminal 1, extinguishes the CON tube.

The CON1 and CON3 capacitors are small and serve to prevent false firing of the CON tube from electrical noise pulses.

E5-3.13.3 Continuity Failure Trouble Record - LTR

If the CON tube fails to fire, the CON and CON1 relays do not operate, and the CM cannot proceed with the call. The work timer which is recycled upon operation of the GLH relay (SFD-E135) times out after 450 to 605 milliseconds. This causes a trouble record showing WT, GLH and all progress punches through the DCT, but does not include the CON punch.

E5-3.13.4 Cancel Continuity - LTR (SFD-E530, E531, E535)

On second trial calls, the operation of the GLH1 relay operates the CON1 relay from ground on the operated TR2C (SFD-E530), thus, automatically canceling the continuity test. On heavy traffic calls, operation of the LXP1 relay with the HTR relay operated (SFD-E531) operates the GT1 relay, thus, canceling continuity test by bypassing operation of both the CON and CON1 relays.

Continuity test can be cancelled on all calls for all markers by operating the CCT key at the master test frame jack lamp and key panel (SFD-E535).

E5-3.14 DOUBLE CONNECTION TEST - HTR/LTR (SFD-E533)

On both light and heavy traffic calls a double connection test is made to ensure that the sleeve of the connection being set up is not crossed with the sleeve of another connection already set up or in the process of being set up. Although operation of the line hold magnet is slightly delayed on light traffic calls, the double connection test is made in the same manner on both light and heavy traffic calls.

When the LXP1, JXP1 and SIA relays have all operated, as previously described, the LXP and JXP relays and the TXP and TXP1 resistance lamps are disconnected from respective leads to line and trunk link frames. At the same time, the DCT relay is connected to the LH- lead to the line link frame. The DCT relay winding now provides the only ground from the CM to keep the hold magnets operated. Bias current through the secondary winding of the DCT relay is such that the DCT relay will operate if there is no other ground feeding the connection such as would occur if the sleeve path were crossed to an established network connection.

E5-3.14.1 Heavy Traffic

On a heavy traffic call the GT1 relay operates upon completion of the crosspoint check (SCD-E5-3.10.1). With the GT1 relay operated, operation of the DCT relay operates the DCT1 relay which locks.

E5-3.14.2 Light Traffic

On a light traffic call, the GT1 relay does not operate until the CON1 relay has operated as a result of a successful or cancelled continuity test. With the GT1 relay operated, operation of the DCT relay operates the DCT1 relay which locks.

E5-3.15 HOLD MAGNET SIMULATION AND CONTROL BY MTC (SFD-E532, E533)

On an originating class of marker test, it is desirable to be able to test the marker using any line location information. To avoid the possibility of having a customers line become locked into the test call if the line should happen to go off-hook during the progress of setting up the test connection, line hold magnet operation is simulated.

E5-3.15.1 NTC Key Normal

The MT11 relay of the CM is operated on test calls. This opens the path over the LH- lead (SFD-E533) to the line link frame which would normally be used to operate the line hold magnet on a service call. Instead, on a test call the path is extended over the LHMT lead to the MTC and

through the MKT2 relay to the LHM relay (NTC key and NTC1 relay normal) (SFD-E532). The LHM relay and the series LHM resistance are chosen to present an impedance to the marker equivalent to that of a line hold magnet.

When the HMS1 relay of the marker operates, the marker applies either the high voltage surge for dual voltage or ground through the winding of the LXP relay to operate the LHM relay of the MTC. The LHM relay operates the LHMA relay which extends the LHMT lead to the LLJ lead. The LLJ lead ties into the J lead of the CM to the trunk link frame at a point ahead of the CH- relay to simulate the path which would have been closed on a service call over the LH- relay lead to the LL, through the junctor and back over the J- lead to the CM. This permits the marker to go through all the motions of crosspoint and double connection checks. It will actually close junctor crosspoints on the LL, but checks are made through the simulated path just described. The CM operates and checks crosspoints on the TL in the normal manner.

E5-3.15.2 NTC Key Operated (SFD-E532, E533, and E539)

The NTC key of the MTC is operated on an originating class of test where it is desired to establish a connection and check the tip, ring and sleeve path through the line link frame using all crosspoints which would be used on a service call except the line hold magnet crosspoints. Use is made of the no test connector access to LL frames.

Operation of the NTC key on originating class of test operates the NTC and NTC1 relays. The operation of the NTC and NTC1 relays prepares the test circuit for operation with the no-test connector.

When the MTC gains access to the no test connector, the F1 relay of the MTC is operated over the SPC lead (SFD-E532). Operation of the F1 relay operates the NTC select magnets, associated with no test connector level assigned to the MTC, on all no test connector switches (see SFD-E539 as well as E533). The F1 relay also connects the NTB relay of the MTC to the no test connector via the NTH lead. The NTH lead is steered through the CM and the HGA- relay of the LL to the winding of the NTC hold magnet of the no test connector associated with the link to be simulated. If the NTC hold magnet is in use, ground on its winding will be fed back to operate the NTB relay of the MTC which locks on its secondary winding and lights an NTB lamp to indicate NO TEST BUSY. If this occurs, simulated hold magnet operation by the no test connector is blocked. The CM work timer times out and a trouble card showing LXPA but not LXP1 would be produced followed by release.

If the NTC hold magnet is not in use, the NTB relay does not operate. Later in the call, when the CM grounds LHMT lead (which on a regular call would operate the line hold magnet), the NTH relay of the MTC is operated. The NTH relay extends ground from the NTB relay normal to the NTH lead to operate the NTC hold magnet of the no test connector, extends the LHMT lead to the S lead, and closes the tip and ring leads to the test circuit trunk appearance on the no-test connector (SFD-E535).

On an originating test the LK1 relay is operated through the operated MC7 relay (SFD-E712). The operated LK1 relay opens the H lead to the no-test connector to release the no-test connector hold magnet which opens the S lead and releases the NTH relay (SFD-E532). At the completion of the terminating stage the marker operates the SCB relay which recloses the H lead so that the no-test connector may be used again for the originating stage.

E5-3.15.3 Dual Voltage Test (SFD-E533)

When dual voltage operation is provided, the LHMT, LLJ and TLH relays of the MTC are connected to the LHMT, LLJ and TLH leads, respectively. If the CM applies the high positive voltage surge to each of these leads, the corresponding relays should operate to light the LHMT, LLJ and TLH lamps, respectively. Current through the lamps also locks the relays. Tests should be made using message register class of service, if provided, to ensure that the high voltage surge is not applied and, therefore, that the LHMT lamp does not light for these classes. The LHMT lamp should light for all other classes. The LLJ and TLH lamps should light for all classes.

E5-3.16 TEST OF FALSE CROSS AND GROUND DETECTION FEATURE (SFD-E535)

E5-3.16.1 FCG Key Normal

With the FCG key normal, the FCG relay of the CM is connected to the network T and R leads prior to operation of the GLH and GLH1 relays. As on service calls, crosses or grounds on the T and R leads will be detected on light traffic calls.

E5-3.16.2 FCG Key Operated

With the FCG key operated, the FA resistor is bridged across the TTT and TRT leads to the marker. This applies a current which should operate the FCG relay causing a trouble card to be produced showing a FCG punch. If the HTR key is operated, the CM should not detect the FCG condition.

E5-3.17 TEST OF CONTINUITY TEST FEATURES (SFD-E535)

E5-3.17.1 CON, RV, AND TCT Keys Normal, TC Key Operated or Normal

With the CON, RV, TCT, and TC keys normal, an operate condition originating at the voltage divider resistors CL, CM and CK, through the CF resistor is applied to the TRT lead. On alternate test calls the RCTA relay of the CM is operated so that the initial continuity test is made on the RING lead (the TRT lead on a test call). The CON tube should fire and the call should be completed. On calls with the RCTA relay of the CM normal, the initial continuity test is made on the TIP lead (the TTT lead on a test call). Since the TTT lead is open, the CON tube does

not fire initially, but (as described for a service call) it should fire after release of the RCTA relay applies the continuity test to the TRT lead. Two consecutive calls should be made to ensure one test with RCTA initially normal and one test with RCTA initially operated. With the TC key normal, a negative bias is applied to the operate path of the CON tube. A test should also be made with the TC key operated to apply a positive bias to the CON tube operate path.

E5-3.17.2 RV Key Operated, CON and TCT Keys Normal, TC Key Operated or Normal

Operation of the RV key with the CON, TCT, and TC keys normal applies the aforementioned continuity operate test condition to the TTT lead instead of the TRT lead. Two consecutive tests should be made to ensure one test with RCTA initially operated and one test with RCTA initially normal. As described previously, The TC key may be operated or normal to apply positive or negative bias to the CON tube operate path.

E5-3.17.3 CON Key Operated, RV, TCT, and TC Keys Normal

With the CON key operated, a loop continuity operate condition is applied across the TRT and TTT leads. The CON tube should fire for OK continuity on its initial attempt whether the RCTA relay is operated or normal.

E5-4 RINGING SELECTION SWITCH CONTROL

The marker receives the equipment location and the ringing information from the NG at the same time. The marker controls the selection of the ringing selection switch for ringing the called station. If the called line is busy the marker will route advance to a tone trunk.

One of two ringing selection switch select magnets (levels 0 or 1) is operated to select the tip and ring conductor to which the ringing should be applied. One of several other select magnets (levels 2 to 8) is operated to select the proper ringing supply. By operating a hold magnet associated with the selected trunk, the proper ringing supply is connected through the crossbar switch crosspoints.

E5-4.1 SETTING THE RINGING SELECTION SWITCH (SFD-E536, E537)

The marker identification of the ringing combination translation is made by one operated RCT1-15 relay, which operates two of the associated ringing selection RS0-9 relays. The RS2-9 relays operate select magnets 2-9 first. The CM RSK (ringing switch select magnet check) relay checks for operation of select magnets 2-9. The operated RSK relay provides battery for operation of select magnets 0 or 1. The CM SRK (start ringing check) relay operates when the select magnets are operated.

E5-4.2 RINGING SWITCH HOLD MAGNET OPERATION (SFD-E537)

The CM checks that an idle channel is available before operating the LI (link idle) relay. The operated LI relay extends ground on the RC lead to operate the RC (ringing control) relay in the trunk. After operation of relay RC, ground is extended from the marker on lead TP to operate the RSW (ring switch) hold magnet. Through the operated RSW crosspoints ground is returned on lead RC through RCK2 resistor to -48 volts to operate the RCK1 (ringing switch check) relay, which operates the RCK2 relay. Through the operated RCK2 and LCH or TCH relays the RCK3 relay is operated, which allows the call to complete.

E5-4.3 RINGING SWITCH SELECT MAGNET SIMULATION BY MTC (SFD-E536)

The KRS relay is operated by the F relay and closes the RS0-9 leads from the marker to the windings of the RS0-9 relays which simulate ringing switch select magnets.

The marker normally grounds the RS0 or RS1 lead and one of the RS2-9 leads, operating the corresponding relays which lock on secondary windings to ground on the RSH relay. Any of the RS0-9 relays operated, grounds the RSK lead to the marker.

Lamps are lighted, on the test panel, by the operated RS0-9 relay to indicate the ringing condition which would have been set up by a ringing switch.

E5-4.4 RINGING SWITCH HOLD MAGNET SIMULATION BY MTC (SFD-E537)

The marker having operated the RC relay, grounds the TP lead to the RSH (ring switch hold magnet) relay which operates, simulating the operation of a ringing switch hold magnet.

When the F relay releases, the holding path of the RSH relay is through the operated RSH and N1 relays to ground through normal contacts of the KR relay.

E5-5 ADVANCE TO CALL BACK

The marker performs some similar functions on both linkages but some functions are used only on CB (call-back), and some are used only on FLG. Accordingly, when the marker advances from the FLG to the CB linkage the marker must:

- (a) Release all apparatus associated with FLG functions that will be reused on the CB linkage.
- (b) Release relays that are only required on FLG.
- (c) Reoperate relays required for CB linkages.

On FLG linkage, the LL information was obtained from the NG and registered on the FTT-, FUT-, VGT-, HGT-, and VFT- relays. When the LK2 relay operates, the above relays are released and then reoperated through the CB-relay contacts from the calling line information as recorded in the originating register.

SECTION E, PART 6

CONNECTION TO LINE LINK FRAME - SCB

Index

	<u>PAGE</u>
E6 CONNECTION TO LINE LINK FRAME - SCB	E6-2
E6-1 LINE LOCATION CONTROL	E6-2
E6-2 LINE LINK FRAME SEIZURE	E6-3
E6-2.1 PREFERENCE CONTROL CIRCUIT	E6-3
E6-2.1.1 MP- Relay Operate Chain	E6-3
E6-2.1.2 MP- Relay Work Chain	E6-3
E6-2.1.3 Emergency Transfer	E6-3
E6-2.1.4 Manual Transfer	E6-3
E6-3 LINE LINK FRAME LOCKOUT	E6-3
E6-3.2.1 Seizure of LLC by CM Before There is a Request for Dial Tone in the LL	E6-4
E6-4 LINE LINK FRAME CONTROL NONPAIRED OPERATION	E6-4
E6-4.1 CROSS DETECTION	E6-4
E6-5 PAIRED LINE LINK FRAMES	E6-5
E6-5.1 PAIRED LL FRAME AUXILIARY LL FRAME IDENTIFICATION	E6-5
E6-5.2 PAIRED LL FRAME MATE SEIZURE	E6-5
E6-5.3 PAIRED LL FRAME AUXILIARY LL CONTROL	E6-5
E6-6 PAIRED LINE LINK FRAME - MARKER GLARE CONDITION	E6-5
E6-7 PAIRED LL FRAME AUXILIARY LL - MAKE BUSY	E6-5
E6-8 CHANNEL PREPARATION	E6-5
E6-9 CLASS-OF-SERVICE	E6-5

E6 CONNECTION TO LINE LINK - SCB

Certain apparatus associated with channel selection, hold magnet control, and line equipment control is released for use with the CB linkage. The equipment location of the calling line is recorded from information contained in the OR. The LL is seized to provide marker control of the calling line.

E6-1 LINE LOCATION CONTROL (SFD-E602)

On the FLG stage of an ITR call the operation of relay LK1 releases relays FLG and FLG1 to begin functions for the SCB (start call back) stage. The ST- lead for the called party LL is operated to release the LL. The operated LK2 relay released relay LLI (lock line identification). Release of relay LLI causes the release of the called party information that was obtained from the NG, by releasing relays FTT, FTL, FUT, VGF-, HGT-, VFT-, HGL, VFL, VGL, etc.

When the CM advances to the SCB stage the progress punches associated with the B appearance of the ITR call and the selected FLG channel goes out. (FBK, SL, LC-, LGK, RK or LK, JCK, TCHK, etc.) The TL information and the CM progression punches that remain from the FLG stage to the SCB stage are: TB-, TG-, FS-, TS-, LV-, FCK, FTCK, CK, FML, MAK1, TM, CKG, GTL, DCT1, LK1, etc.

On an ITR call the CB and CR1 (call back) relays are operated by ground through the operated LK1 and ITR1 relays (SFD-E603) and the normal relays that were used to identify the called line location on the FLG stage. CB2 through CB5 relays are now operated to provide translation of line location through operated contacts. The CM receives calling line identification from the OR which is registered on the FT-, FU-, VG-, HG- and VF- relays and produces the FT'-, FU'-, VG'-, HG'-, and VF'- prime punches. This information along with the LL-, indicating which line linkage was used on the dial tone call, gives a translation as to the line location of the calling line. This is further checked in the CM, by checking the proper number of relays operated and if the correct number of relays are operated, operates the RK1, RK2 and RK3 (line link location check) relays. The RK2 and RK3 progress punches are an indication of the line link location check. The calling line location is registered on the FTT-, FUT-, VGT-, HGT-, and VFT- relays and the FTT- and FUT- relays in operating select the LL. The VGT- and the HGT- relays then operate the associated VGB- and HG- relays in the LL. The HG- relay in operating closes through the LB- and LL test leads for testing the LL, and closes through the SM- leads to operate the LL select magnet. The VGB- and the HG- relays operate the associated LG- relay in the LL. The operation of the LG- relay closes through the LG- leads to the VFT- relay for controlling the operation of the proper LL hold magnet.

E6-2 LINE LINK FRAME SEIZURE

On SCB stage the LL frame for the calling subscriber is seized by battery over the ST- lead through the LLC to operate the MP- relay and associated LLC multicontact relays. The LFS resistance battery is extended through the operated LLC2, TFK2, SCB2, FUT-, and FTT- relays to the required ST-lead. The LFK punch is an indication that all LLC relays have properly operated.

E6-2.1 PREFERENCE CONTROL CIRCUIT

The relay operation is the same as for FLG, see SFD-E405 and SCD-E4-1.1.

E6-2.1.1 MP- Relay Operate Chain

The relay operation is the same as for FLG, see SCD-E4-1.1.1.

E6-2.1.2 MP- Relay Work Chain

The relay operation is the same as for FLG, see SCD-E4-1.1.2.

E6-2.1.3 Emergency Transfer

The relay operation is the same as for FLG, see SCD-E4-1.1.3.

E6-2.1.4 Manual Transfer

The relay operation is the same as for FLG, see SCD-E4-1.1.4.

E6-3 LINE LINK FRAME LOCKOUT

When a LL has seized a DTM via its LLMC, it is possible that a CM may seize the LL via its LLC before the DTM can seize the LLC. If the GM is setting up a connection from a calling line to a trunk, it must release the connection already established from that line to an OR before it can set up a new connection from that line to a trunk. When this occurs, the L relay for that line reoperates momentarily. The DTM must be prevented from attempting to identify this operated relay as a request for dial tone. If a CM has connected to a LL before there is a request for dial tone in the LL, the LL is prevented from requesting a DTM until the CM has released the LLC.

E6-3.1 SEIZURE OF DTM VIA LLMC BEFORE CM SEIZES LLC (SFD-E604)

If a LL has connected to a DTM via a LLMC but a CM connects to the same LL via a LLC before the DTM does, the DTM is not permitted to proceed with horizontal group selection until the CM completed its use of the LLC.

Whenever any VGS-relay operates in a LL, it operates the DT relay (SFD-E604) as an indication that there is a request for dial tone. If a CM seizes the LLC for that LL to establish a connection from a calling line to a trunk, its CB2 relay will be operated. The CB2 relay operates the LOT relay (SFD-E604). When the CM proceeds to the point of operation of the TCHK relay, it grounds the G lead toward the LL via the LLC. If the DT relay is operated in the LL, the ground is extended over the DTK lead to operate the DTK relay in both the CM and the DTM. Operation of the DTK in the DTM opens the operate path of the HGG- relay (SFD-E604) on first trial calls. This prevents horizontal group selection, if not already completed, by the DTM until the CM has released the LLC.

The release of the HGG relay opens the HGT- leads (SFD-B109) preventing horizontal group selection. If, however, horizontal group selection had been completed before the DTK relay operates, the HGG relay would have already been released by the operation of the HGK relay and the operation of the DTK relay would have no effect.

E6-3.1.2 Seizure of LLC by CM Before There is a Request for Dial Tone in the LL

If a completing marker, setting up a connection from a calling line to a trunk, seizes a LLC and has proceeded to operation of its TCHK relay before a request for dial tone has operated the DT relay in the LL, the LL is prevented from requesting a connection to a DTM until the CM has released the LLC.

When the CB2 relay of the CM operates, it operates the LOT relay (SFD-E604). When the TCHK relay operates, ground on the G lead through the normal DT relay in the LL operates the LO relay in the LL. The LO relay operated opens start battery to the MSA and MSB terminals (SFD-B102) preventing a request for a DTM. Operation of the LO relay also prevents operation of the TM and TM1 relay when a VGS- relay operates, so that the TM timer (SFD-E604) does not start until the LO relay releases.

E6-4 LINE LINK FRAME CONTROL NONPAIRED OPERATION

The relay operation is the same as for FLG, see SCD-E4-2.

E6-4.1 CROSS DETECTION

The relay operation is the same as for FLG, see SCD-E4-2.1.

E6-5 PAIRED LINE LINK FRAMES

The relay operation is the same as for FLG, see SCD-E4-3.

E6-5.1 PAIRED LL FRAME AUXILIARY LL FRAME IDENTIFICATION

The relay operation is the same as for FLG, see SCD-E4-3.1.

E6-5.2 PAIRED LL FRAME MATE SEIZURE

The relay operation is the same as for FLG, see SCD-E4-3.2.

E6-5.3 PAIRED LL FRAME AUXILIARY LL CONTROL

The relay operation is the same as for FLG, see SCD-E4-3.3.

E6-6 PAIRED LINE LINK FRAME - MARKER GLARE CONDITION

The relay operation is the same as for FLG, see SCD-E4-4.

E6-7 PAIRED LL FRAME AUXILIARY LL - MAKE BUSY

The relay operation is the same as for FLG, see SCD-E4-5.

E6-8 CHANNEL PREPARATION (SFD-E602)

The relay operation for channel preparation will be the same as it was for FLG shown on SFD-E502 and SCD-E5. SFD-E202 indicated the FLG stage and operation of the FBK relay. On the SCB stage with the SCB1,2 relays operated, the FAK relay operates (SFD-E211), and the LC relay operation will indicate the "A" appearance location of the ITR trunk.

E6-9 CLASS OF SERVICE (SFD-E602)

The CST, CSU and CSK relay operation shown on SFD-E602 are not required for class-of-service information on SCB. The relay operation is required to provide operate paths for the AOC, AOA, DVO, and DVA relays in order to supply dual voltage operation for the hold magnets as described in SCD-E5-3.8.

SECTION E, PART 7

CHANNEL SELECTION AND HOLD MAGNET OPERATION

Index

	<u>PAGE</u>
E7	NETWORK CONNECTIONS
	E7-2
E7-1	CHANNEL ARRANGEMENTS
	E7-2
E7-1.1	JUNCTOR SEQUENCE CONTROL
	E7-2
E7-1.1.1	Control of Junctor Sequence by Master Test Control
	E7-2
E7-1.2	SELECTION OF A CHANNEL
	E7-2
E7-1.3	NO IDLE CHANNEL, RECYCLE, FAILURE TO MATCH, ROUTE ADVANCE
	E7-2
E7-1.4	CONTROL OF CHANNEL SELECTION BY MASTER TEST CONTROL
	E7-2
E7-2	SELECT MAGNET OPERATION
	E7-3
E7-3	HOLD MAGNET OPERATION - NETWORK AND LINE TEST
	E7-3
E7-3.1	CROSSPOINT CHECK - HTR/LTR
	E7-3
E7-3.2	FALSE CROSS AND GROUND TEST - LTR
	E7-3
E7-3.3	DELAYED OPERATION OF LINE HOLD MAGNET - LTR
	E7-3
E7-3.4	CONTINUITY TEST, GENERAL - LTD
	E7-3
E7-3.5	DOUBLE CONNECTION TEST - HTR/LTR
	E7-3
E7-3.6	HOLD MAGNET SIMULATION AND CONTROL BY MTC
	E7-3
E7-3.7	TEST OF FALSE CROSS AND GROUND DETECTION FEATURE
	E7-3
E7-3.8	TEST OF CONTINUITY TEST FEATURES
	E7-3
E7-4	LINKAGE CHECK
	E7-4

E7 NETWORK CONNECTIONS

The channel test leads are closed for the call-back linkage to select an idle channel between the calling customer and the other end of the ITR trunk, and the select and hold magnets are operated to connect the linkage through the LJ and TL frames.

E7-1 CHANNEL ARRANGEMENTS

The relay operation is the same as for FLG, see SCD-E5-1.

E7-1.1 JUNCTOR SEQUENCE CONTROL (SFD-E708, E507)

The relay operation is the same as for FLG, see SCD-E5-1.1.

E7-1.1.1 Control of Junctor Sequence by Master Test Control (SFD-E507)

The relay operation is the same as for FLG, see SCD-E5-1.1.1.

E7-1.2 SELECTION OF A CHANNEL (SFD-E525)

The LLC1, CHT, SLRK and CB5 relays will have operated early in the call. When the LOT and DTK (SFD-E604) relays operate, ground is closed to operate a CH0-9 relay. There is a double chain path composed of CHT0-9 relays and TCH0-9 relays to determine which CH0-9 relay, if any, is to be operated. Some, or all, of the TCH- relays (SFD-E522) will be operated as an indication of which channels are provided in the subgroup being tested. Any channel which is busy (SFD-E524) will have an operated CHT relay. If the TCH0 relay is operated and the CHT0 relay is normal, the CH0 relay operates and locks. If, however, either TCH0 relay is normal or CHT0 relay is operated, ground is passed to operate the next relay in the chain which has an operated TCH relay and a normal CHT- relay. When one CH- relay has operated and all others are normal, the CHA relay operates as an indication that a channel has been selected.

E7-1.3 NO IDLE CHANNEL, RECYCLE, FAILURE TO MATCH, ROUTE ADVANCE (SFD-E525, E704, E705, E706, E707, E517, E519)

The relay operation is the same as for FLG, see SCD-E5-1.18.

E7-1.4 CONTROL OF CHANNEL SELECTION BY MASTER TEST CONTROL (SFD-E522, E709)

The relay operation is the same as for FLG, see SCD-E5-1.20.

E7-2 SELECT MAGNET OPERATION

The relay operation is the same as for FLG, see SCD-E5-2 through SCD-E5-3.2.

E7-3 HOLD MAGNET OPERATION - NETWORK AND LINE TEST

The relay operation is the same as for FLG, see SCD-E5-3 through SCD-E5-3.9.

E7-3.1 CROSSPOINT CHECK - HTR/LTR

The relay operation is the same as for FLG, see SCD-E5-3.10 through SCD-E5-3.10.2.

E7-3.2 FALSE CROSS AND GROUND TEST - LTR

The relay operation is the same as for FLG, see SCD-E5-3.11.

E7-3.3 DELAYED OPERATION OF LINE HOLD MAGNETS - LTR

The relay operation is the same as for FLG, see SCD-E5-3.12.

E7-3.4 CONTINUITY TEST, GENERAL - LTR

The relay operation is the same as for FLG, see SCD-E5-3.13 through SCD-E5-3.13.4.

E7-3.5 DOUBLE CONNECTION TEST - HTR/LTR

The relay operation is the same as for FLG, see SCD-E5-3.14 through E5-3.14.2.

E7-3.6 HOLD MAGNET SIMULATION AND CONTROL BY MTC

The relay operation is the same as for FLG, see SCD-E5-3.15 through SCD-E5-3.15.3.

E7-3.7 TEST OF FALSE CROSS AND GROUND DETECTION FEATURE

The relay operation is the same as for FLG, see SCD-E5-3.16 through SCD-E5-3.16.2.

E7-3.8 TEST OF CONTINUITY TEST FEATURES

The relay operation is the same as for FLG, see SCD-E5-3.17 through SCD-E5-3.17.3.

E7-4 LINKAGE CHECK (SFD-E710)

On ITR calls, the operation of LK1 relay initiates the call back operations. When the linkage check is made for the call back portion of the ITR call, the DCT2 relay operates to indicate a satisfactory linkage check.

SECTION E, PART 8
COMPLETING MARKER RELEASE

Index

		<u>PAGE</u>
E8	COMPLETING MARKER RELEASE, RINGING CALLED SUBSCRIBER AND DISCONNECT	E8-2
E8-1	MARKER NORMAL RELEASE - OPERATION OF THE DIS1,2 RELAYS	E8-2
E8-1.1	TROUBLE RECORD - OPERATION OF THE TRR RELAY	E8-2
E8-2	MARKER TROUBLE RELEASE - OPERATION OF THE TRL RELAY	E8-3
E8-2.1	LINE LINK FRAME MAKE BUSY	E8-3
E8-2.2	TROUBLE RECORD - OPERATION OF THE TR1 RELAY	E8-4
E8-3	MARKER OVERALL TIME-OUT RELEASE - OPERATION OF THE MRL, MRL1 RELAYS	E8-4
E8-4	CONTROL OF MARKER RELEASE BY THE MASTER TEST CONTROL CIRCUIT	E8-4
E8-5	REQUESTING TROUBLE RECORD USING MTC CIRCUIT - OPERATION OF THE REC RELAY	E8-5
E8-6	TROUBLE RECORDER REQUEST	E8-5
E8-7	TROUBLE RECORDER BUSY	E8-6
E8-8	RINGING THE CALLED SUBSCRIBER	E8-6
E8-9	CALLED SUBSCRIBER ANSWERS	E8-7
E8-10	DISCONNECT	E8-7
E8-10.1	CALLED SUBSCRIBER DISCONNECTS FIRST	E8-7
E8-10.2	CALLING SUBSCRIBER (OR STATION) DISCONNECTS FIRST	E8-7

E8 COMPLETING MARKER RELEASE, RINGING CALLED SUBSCRIBER AND DISCONNECT

The completing marker disconnects and restores to normal leaving the established ITR connection under supervisory control of the ITR trunk.

The completing marker may encounter numerous conditions that require disconnect, and when these conditions occur the completing marker has various methods of disconnection.

When the F relay in the ITR trunk is released, the ringing selection switch supplies ringing to the called subscriber. After the called subscriber answers and conversation is complete, there may be two types of disconnect. The calling subscriber may disconnect first or the called subscriber may disconnect first.

E8-1 MARKER NORMAL RELEASE - OPERATION OF THE DIS1,2 RELAYS (SFD-E802, E806)

On ITR calls, the operation of LK1 relay initiates the call back operations. When the linkage check is made for the call back portion of the ITR call, the DCT2 relay operates to indicate a satisfactory linkage check, and when the DCT relay releases, it directs the call to disconnect by operating the DIS1,2 relays.

On calls other than ITR, the LK1 relay operated causes the operation of the DIS1,2 relays.

The DIS1,2 relays, operating, release the CKG1,2 relays in the CM and grounds the MRL lead into the OR (originating register) to operate the MRL relay (SFD-E107). The MRL relay, operating, releases the MS- relay in the ORMC, and by opening the start lead into the connector prevents a second trial (SFD-E104).

E8-1.1 TROUBLE RECORD - OPERATION OF THE TRR RELAY (SFD-E806)

There are conditions whereby the CM detects trouble and, before releasing, takes a trouble record by operating the TRR (trouble record regular) release relay. These conditions are as follows:

When the marker receives a permanent signal indication from the OR, the PS relay in the CM operates. If the APS (all permanent signal) key is operated at the JLK bay, the PSR relay in the CM operates. The PSR and PS relays operate the TRR relay in the CM and a trouble record is taken. The permanent signal trouble record is used to obtain the line information.

When the start lead is shifted to an alternate marker in the ORMC due to a delay in the selection of a marker, the TRS (transfer start) relay in the PC circuit operates. After the alternate marker is selected, the TRS relay in the CM operates. The TRS relay operates the TRR relay in the CM and a trouble record is taken. The TRS trouble record is used to identify the connector used on the call.

A time-out or cross failure will cause the CM to take a trouble record. If the marker usage is a first trial (TR2C relay normal) and the dialing connection has released (CB5, CHA, and TK relays operated), the TRR relay in the CM operates and a trouble record is taken. A second trial is not possible on this type of call because the OR has already released.

If the F terminal of a number in the NG is connected to the PBN or PMO lead, the CM will cause the line-busy or overflow signal to be returned on calls to these numbers. The PBN feature is also used on test calls to test the ability of trunk circuits to return a line busy signal where a busy line is encountered (SFD-E312).

When the trouble record is completed, the DIS1,2 relays in the CM operate from the operated RDL, TRB1, TRSA and TRR relays. The marker then releases on a normal basis.

E8-2 MARKER TROUBLE RELEASE - OPERATION OF THE TRL RELAY (SFD-E806)

If the CM encounters trouble while trying to complete the call, the TRL (trouble release) relay in the marker will operate. The TRL relay operating releases the CKG1,2 relays in the CM and grounds the TRL lead into the PC (perference control circuit) operating the TRL relay (SFD-E107). The TRL relay operating releases the MS- (marker start) relay in the ORMC. The Z relay in the PC changing condition shifts the ST (start lead) to the alternate marker and a second attempt is made to complete the call (SFD-E104). A trouble release permits a second trial providing the MRI or BT relays in the OR (originating register) are normal.

E8-2.1 Line Link Frame Make Busy

When a plug is inserted into the LMB jack at the LLF, the MB relay operates in the PC circuit. The MJ relay in the JLK circuit then operates and a major alarm is sounded.

As a result of the MB relay operating, the LLB relay in the marker (SFD-E404) operates and removes battery from the start lead. The LLB relay operates the RBT relay which operates the RDL and then the TRL which releases the marker on a trouble basis.

E8-2.2 TROUBLE RECORD - OPERATION OF THE TR1 RELAY (SFD-E806)

There are conditions whereby the CM detects trouble and, before releasing, takes a trouble record by operating the trouble record trouble release TR1 relay. These conditions are as follows.

A time-out or cross failure will cause the CM to take a trouble record. If the marker usage is a first trial (TR2 relay normal) and the dialing connection has not released (CB5, CHA, or TK relays normal), the TR1 relay in the CM operates and a trouble record is taken. A second trial is possible on this type of call because the OR is still attached to the circuit. If the marker usage is a second trial, TR2C relay operated, the TR1 relay in the CM operates and a trouble record is taken. Since the marker usage is a second trial, the BT relay in the OR will operate opening the start lead preventing another attempt to complete the call.

When the trouble record is completed, the TRL relay in the CM operates from the operates TR1, TRB1, RDL, and TRSA relays. The marker then releases on a trouble basis.

E8-3 MARKER OVERALL TIME-OUT RELEASE - OPERATION OF THE MRI., MRL1 RELAYS (SFD-E135)

If the marker fails to complete the call within the allotted interval of 9.6 to 15.4 seconds, the OAT timer functions and causes the MRL (marker release) relay to operate. The MRL relay operates the MRL1 relay (SFD-E806) which operates the busy test BT and MRL relays in the OR (SFD-E107). The MRL relay operating releases the MS- relay in the ORMC and by opening the start lead into the connector prevents a second trial (SFD-E104).

On this type of release, a trouble record is not taken but the TA (timing alarm) lamp will be lighted on the equipment frame.

E8-4 CONTROL OF MARKER RELEASE BY THE MASTER TEST CONTROL CIRCUIT (SFD-E710 AND E806)

On test calls certain MT- (marker test) relays operate in the CM. These test relays operating allow the MTC circuit to interact with the marker.

With the MT17 relay operated in the CM, the DCT1 relay operating path is extended into the MTC circuit over the TDCT lead. The DCT1 relay operating ground is extended over the DCT lead into the MTC circuit to operate the DCT relay. With the REC key normal, the operation of the DCT relay in the MTC circuit operates the M01 relay. The M01 relay in the MTC circuit operating connects ground to the TDCT lead into the CM operating the DCT1 relay. The CM then continues its progress on a normal basis.

With the MT1 relay operated in the CM, the DIS1,2 relays operating path is extended into the MTC circuit over the DIS lead. After the LK1 (linkage check) relay in the CM operates, ground is extended over the LK2 lead into the MTC circuit. The LK2 relay in the MTC operates, lighting the LK2 lamp. Ground is now transmitted over the LK3 lead through the CM and back into the MTC on the DIS1 lead. The DIS1,2 relays in the MTC circuit operate, lighting the DIS1 lamp, and ground is extended over the DIS lead into the CM operating the DIS1,2 relays. The CM then gives a normal release. It may be noted that if the LK2 and DIS1 lamp at the MTC panel are both lighted, the marker has completed setting up the connection and released.

E8-5 REQUESTING TROUBLE RECORD USING MTC CIRCUIT - OPERATION OF THE REC RELAY (SFD-E806)

When it is desired to obtain a record of the progress of the CM when making a test call, the REC key (record request) should be operated at the MTC panel. The REC key operates the REC relay in the MTC after the DCT relay has operated. Thus, the REC relay is operated prior to the completing marker DCT1 relay. The REC relay operated extends ground into the CM over the TRR lead to operate the TRR relay. The TRR relay operates the TRST (trouble recorder start) relay in the CM which operates the MPR- marker preference relay in the MTFC to request a trouble record. A trouble record is taken and the CM releases on a normal basis. These trouble records requested by the test equipment can be distinguished from service or legitimate trouble records by the absence of the TI (trouble indication) punch on the trouble record card.

E8-6 TROUBLE RECORDER REQUESTS (SFD-E807)

When the marker encounters a trouble condition, the TRR or TR1 relay will operate in the CM and cause the trouble recorder to be seized by the trouble recorder start relay operating (SFD-E806). The TRST operates the TRSA relay in the marker. On first trial calls, the MN relay in the JLK circuit operates and a minor alarm is sounded. On second trial calls, the MJ relay in the JLK circuit operates and a major alarm is sounded. The marker preference MPR- relay in the MTFC circuit is then operated (SFD-E807) from battery on the TRST lead. The MPR- relay connects ground to the CI lead which operates the MKA, MKB, and MKB1 relays in the MTFC. The MKA relay operates the MTR (marker test repeat) relay which operates the CIC (cut-in connector) relay in the MTFC (SFD-E807) and a trouble record is taken.

After the trouble record is complete, ground over the TRC lead from the TRC (trouble recorder control) circuit operates the TRC and TRC1 (trouble record complete) relays in the MTFC. The RM (release marker) relay in the MTFC operates and ground is transmitted over the TRB lead into the CM to operate the TRB1,2 (trouble recorder busy) relays. The TRB1 relay operating removes battery from the TRST lead releasing the MPR- and MKA relays in the MTFC. The TRB2 relay operates the RDL (release delay) relay in the marker. The marker will then release on a normal or trouble basis.

E8-7 TROUBLE RECORDER BUSY - (SFD-E807)

When a trouble record is requested by the marker with the operation of the TRR or TR1 relays and there is a previous trouble record in progress with the TRB1 relay operated, the DL (display lost) relay in the marker will operate. The DL relay operating will cause the DL- (display lost) lamp in the JLK circuit to light, indicating the loss of a trouble record. The marker will then release on a normal or trouble basis.

E8-8 RINGING THE CALLED SUBSCRIBER (SFD-E808, E809)

The marker causes the ringing selection switch to connect to this trunk by operating the RC relay over the RC lead. The RC relay then energizes the hold magnet of the switch vertical assigned to this trunk over the H and B leads. The RC relay connects the ringing supply leads to the called end of this trunk in preparation for ringing the called line. The RC relay also establishes a check circuit from the operated S1 relay through the closed contact of the ringing selection switch to the marker, over the RC lead.

When the RC check has been received and when the switches have been set up by the marker, the marker releases the trunk F relay. This causes the two trunk connector relays, FA and FB, to connect the trunk to the switches. The calling end supervisory relay, S, will operate at this time and hold the S1 relay operated.

In offices serving only individual and two party lines, ringing current will be connected to the called party immediately. In offices serving lines with more than two parties, and except for code 1 stations, ringing will await the operation of the PU relay on the next closure of the pick-up interrupter, thus starting machine ringing at the beginning of the code. When code 1+ or 1 Gen is set the ringing selection switch closes a circuit over lead PKU to operate the PU relay and thus start ringing immediately. In either case, the PU relay locks to ground from the S1 relay under control of the RC relay and connects ringing current through the winding of RT relay and contacts of RC relay to the called line. Ringing current is returned to the calling subscriber through the T1 and R1 capacitors as an audible indication that ringing has begun.

The operated ringing switch hold magnet closes crosspoints of the two selected levels to extend ringing current and ground to the T and R leads of the trunk circuit. The path of ringing current may be traced from the ringing supply through crosspoints of selected level 2-8; to the RT lead, through the RT relay in the ITR trunk circuit, to the RB lead, through crosspoints of level 0 or 1, to T or R lead, through called subscribers subset back to level 0 or 1 to ground.

E8-9 CALLED SUBSCRIBER ANSWERS

When the called subscriber removes the receiver to answer the call, the RT (ringing trip) relay operates from the increased current flow through the subset. The RT relay opens the locking path for the RC relay causing it to release. The released RC relay reconnects the called line to the S relay causing the S relay to operate. The released RC relay also causes a 10 ohm ground to be connected to the channel of the called line to hold the channel operated and releases the PU relay. The S relay is also in the path to keep the channel operated and, if supervision is required for billing purposes, operates the T relay.

E8-10 DISCONNECT (SFD-E805)

After conversation has ended, disconnect from the line varies, depending on whether the called subscriber or the calling subscriber disconnects first.

E8-10.1 CALLED SUBSCRIBER DISCONNECTS FIRST

When the called subscriber disconnects, the S relay releases. The released S relay removes the holding ground from the sleeve lead and releases the T relay, if it is operated. The T relay restores the original trunk polarity as a disconnect signal to the distant office. When the calling end disconnects, the A relay in the incoming trunk releases, opening the locking path of the D relay. The released D relay releases the CO relay, the ringing switch vertical and the connection to the calling line. This restores the trunk and network connection to normal.

E8-10.2 CALLING SUBSCRIBER (OR STATION) DISCONNECTS FIRST

When the calling subscriber disconnects first, the A relay releases, in turn releasing the D relay. The released D relay releases the CO relay, the ringing selection switch, and opens one holding path to the called subscribers channel. The channel to the called subscriber will be held

operated through the S relay operated and the RC relay released. The CO relay released with S relay operated establishes a path to the heater element of the thermo controlled RL relay. In 13-32 seconds, the RL relay operates and causes the RC relay to operate. The operated RC relay opens the path to the called subscribers channel. This releases the channel which opens the T and R to the trunk. The open T and R leads release the S, RC, and RL relays and restores the trunk to normal.

SECTION E, PART 9

MAINTENANCE

Index

		<u>PAGE</u>
E9	MAINTENANCE	E9-1
E9-1	USE OF THE MASTER TEST CONTROL FRAME TO SIMULATE CALLS WHICH PRODUCE TROUBLE RECORD CARDS	E9-2
E9-2	USE OF SIMULATED TABLE AND ILLUSTRATED RECORD CARD	E9-2
E9-2.1	FUNCTIONS OF ORIGINATING CLASS OF CALL (ITR)	E9-3
E9-3	USE OF CLASS OF TEST TABLES	E9-5
E9-4	ORIGINATING CLASS OF MARKER TEST	E9-5
E9-5	ITR CLASS OF TRUNK TEST	E9-6

E9 MAINTENANCE

This part of the E section covers some of the aspects of the use of the master test control frame to detect, locate, and clear trouble on intra-office type calls.

E9-1 USE OF THE MASTER TEST CONTROL FRAME TO SIMULATE CALLS WHICH PRODUCE TROUBLE RECORDS

Analysis of trouble record cards using the trouble analysis chart and sequence charts of part E0, localize the trouble to an area which may involve a path through one or two relay contacts within one circuit, or may involve a path through many relay contacts in several circuits. Generally, it is impossible to troubleshoot the path on a static basis. The contacts which close, to establish the path are often closed for only a fraction of a second during marker holding time. Frequently, the path which produced the failure is used only when a particular configuration of circuits or network paths is used. For this reason, it is desirable to be able to reproduce the same condition which caused the trouble in the beginning. The master test control circuit provides the means for such controlled simulation of actual calls without affecting service.

E9-2 USE OF SIMULATION TABLE AND ILLUSTRATED TROUBLE RECORD CARDS

The purpose of simulation tables in SFD-E902, E904, and E906, is to correlate trouble record card designations with the key(s) or switch(es) of the master test control frame, which should be operated to provide input or control to the CM when simulating a trouble record card. Included, for easier reference, is a trouble card designation location for different types of trouble cards. The three types of trouble record cards illustrated are E-5488 (2/X double sided) shown on SFD-E903, E-4393 (1/X double sided) shown on SFD-E905, and E-3638 (1/X single sided) shown on SFD-E907.

The drawing in SFD-E903, E905, and E907 depict a trouble record card which includes all of the possible designations (colored) which might be perforated on a record produced by an intraoffice type call. A color key arrangement is used to indicate the different functions of designations regarding marker input or output information, progress of call, circuits or paths used, etc.

E9-2.1 FUNCTIONS OF ORIGINATING CLASS OF CALL (ITR)

One of the tables on SFD-E902, E904, or E906 and the associated colored trouble record card which corresponds to the type of trouble record card being analyzed should be used. The tables are divided into two parts. The left hand side of the chart shows functions used, designations perforated, and the designation location on a particular trouble record card. The right hand side of the chart lists the different key(s) or switch(es) used to simulate trouble record indications, depending on the type of master test control frame provided. The following is a brief description of the key and switch arrangements and their relationship to the trouble designation for each of the functions listed in above tables.

- (a) Select the ITR class of marker test, by operating the ORIG, or IAO key, if provided, or set the TSTA or TSTB switch to the required position.
- (b) Select class of call and type of translation. On some types of master test control frames local translation is prewired and no key need be operated.
- (c) Select the particular CM which produced the record.
- (d) Digits A (0-9) through G (0-9) can be operated to simulate the called number registered on the trouble record card.
- (e) Set up the line location indicated by the trouble record card. (Used only on ORIG class of test.)
- (f) Operate the class-of-service key(s) or switch(es) as indicated on the trouble record card.
- (g) With the FS/NTFS key normal, the CM selects a trunk link frame in the same manner that it would on a service call. By operating the FS key along with the FG(0-2) key and an FS(0-9) key or the FS(0-9) switch, the CM selects a trunk link frame in the normal manner but is restricted to selecting only that trunk link frame corresponding to the operated FS(0-9) keys or switch. The NTFS key is intended for use when it is desirable to select a trunk which is maintenance busy. An operated NTFS key permits selection of a particular trunk link frame (under control of the FG(0-2) and FS(0-9) keys without first testing for idle trunks on that trunk link frame.

- (h) With the TS/NTTS key normal, the CM selects a trunk in the normal manner. With the TS key operated (along with the TS0-19 key or the TST1 key with TSU0-9 switch), the CM selects a trunk in the normal manner, but is restricted to selecting only that trunk corresponding to the operated TS0-19, or the setting of the TST1 key and TSU switch. With NTTS key operated, control of trunk selection by the marker is similar to TS key operated. However, in addition, the TST relay in the trunk link frame is operated. When the TST relay operates, all trunks which are made busy on the trunk link frame are restored to service (MB relay releases). It is, therefore, possible to select a particular trunk with TS(0-9) key operated, which is maintenance busy. The maintenance busy condition is removed only during the time that the marker (engaged on the test call) is connected to the trunk link frame.
- (i) If allotted trunk groups are furnished, the GPA or GPB key is operated. The marker will operate with the corresponding allotter group and will not advance from one to another.
- (j) A particular path through the network from a line in a particular horizontal group on a line link frame to a trunk on a particular trunk switch of a trunk link frame is defined by channel number and junctor group.
 - (1) Operation of a CH(0-9) key or the CH(0-9) switch will direct the CM to select that channel number.
 - (2) Selection of a particular junctor group is not quite as straightforward. Reference should be made to the chart on SFD-E908 to select the horizontal line of the chart corresponding to the size of office. Note that the same junctor group may be selected in two or more junctor sequence positions and is dependent on junctor step position 1 or 2.
 - (3) The JSQ(0-5) key or switch should be operated to select a junctor sequence position which associates with the junctor group for the junctor step selected. In some cases, the JSQ(0-5) key or switch might be set in any of several positions to select the desired junctor group.
- (k) With the TR2 key normal, a first trial call is simulated. Operating the TR2 key simulates a second trial call.
- (l) With the OBS key normal, a nonobserved call is simulated, and operating the key simulates an observed call.

E9-3 USE OF CLASS OF TEST TABLES

The class of test tables shown on SFD-E910 through E912 summarize, in tabular form, the key(s) and switches(es) used to establish a particular class of test. A single line is used to separate a particular function with its associated figure, option, key, or switch. The double line within the single lines is used to separate the various options on vintages of master test control frames. The note column and sheet notes are as follows:

- (a) Note 1 indicates that all key(s) or switch(es) must be operated to make a proper test frame setup for the particular class of test. It is suggested that known working equipment must be selected for test.
- (b) Note 2 indicates the key(s) or switch(es) to be used to simulate the trouble record. Refer to simulation tables in SFD-E902, E904, or E906 and their associated colored trouble record card on the opposite pages (E903, E905, or E907) of the simulated table selected. The tables and colored trouble record cards, along with the class of test tables, will assist the maintenance personnel in selecting the proper key(s) or switch(es) to be operated in order to properly simulate the reported trouble condition.
- (c) Note 3 indicates those key(s) or switch(es) used for additional marker tests but they are not necessarily required for trouble record test or simulation test.

E9-4 ORIGINATING CLASS OF MARKER TEST SFD-E910, E911

On an originating class of marker test, the MTC (master test control) circuit simulates an originating register. To perform this task, the master test frame is first primed with code and digits, originating line location, class-of-service, and other information which it would normally receive from an originating register. After receiving input information from the MTC, the marker proceeds to function in accordance with its translation of the information received to set up a connection.

The originating class of marker test can be used in different types of call arrangements which are listed below.

- (a) SOG - Establishes a path from the originating line location to an outgoing trunk with or without a sender attached (SFD-C810 and C811).

- (b) IAO - Establishes a path from the terminating line location to an intraoffice trunk (terminating stage) or from the originating line location to the intraoffice trunk (originating stage) SFD-E910, E911.
- (c) IMG - Establishes a path from the originating line location to an intermarker group trunk with sender attached.
- (d) REV - Establishes a path from the originating line location to a reverting trunk (SFD-C812 and C813).

NOTE: The test arrangements for paragraphs (a) and (d) above is described in maintenance section of SCD-C and paragraph (c) above is described in SCD-F.

E9-5 ITR CLASS OF TRUNK TEST - SFD-E912

The IAO class of trunk test is used for testing intraoffice trunks where the connection is to be completed to the trunk test circuit terminating test line. The master test control circuit connects to the trunk test circuit and signals it to prepare for an IAO class of test. The test circuit proceeds to connect to a marker which it directs to set up a connection to the intraoffice trunk to be tested.

The IAO class of trunk test is also used for testing subscriber-to-subscriber intermarker group trunks where the test is to be completed to the trunk test circuit terminating test line in the called office.

In the IAO class of test the originating end of the intraoffice trunk circuit is connected to the originating test line and the terminating side to the terminating test line.

The following list of test can be made:

- (a) Test continuity of terminating tip, ring, and sleeve.
- (b) Test continuity of originating tip, ring, and sleeve.
- (c) Tests polarity of terminating tip and ring.
- (d) Tests polarity of originating tip and ring.
- (e) Tests operation of calling party supervisory relay S of trunk.
- (f) Indicates code, polarity, and side of line of ringing.

- (g) Applies pretrip test.
- (h) Applies trip test.
- (i) Tests ability of trunk circuit to transmit tone.
- (j) Tests S1 relay of trunk for minimum holding time.
- (k) Provides means of applying called party supervision.
- (l) Provides operate current to called party supervisory relay CS of trunk circuit.
- (m) Test CS relay of trunk for release.
- (n) Provides means of testing trunk for timed automatic release with terminating end holding. Stopwatch is used to check the time.
- (o) Provides means of testing trunk for timed automatic release with originating end holding. Stopwatch is used to check the time.
- (p) Provides means of testing that when free number of terminating test line is called there is no false charge.

